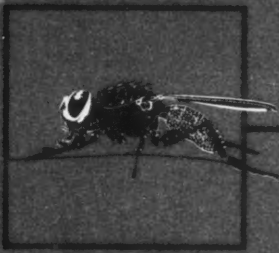
A COMPENDIUM OF INFORMATION ON
PESTICIDES
USED IN ATLANTIC CANADA



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Environment Canada
Environmental Protection Branch
Atlantic Region

Environnement Canada
Direction de la Protection de l'environnement
Région de l'Atlantique

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A COMPENDIUM OF INFORMATION ON
PESTICIDES
USED IN THE ATLANTIC REGION

Environmental Protection Branch
Atlantic Region
2004

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Calculated and Label Suggested Aquatic Set Backs

Foreward

This update of the Pesticide Compendium is the 6th revision of the original 1981 document assembled by Environmental Protection, Environment Canada, Atlantic Region.

The list of chemicals used as a basis for this compendium was compiled using 2001 pesticide sales data. This edition reflects current regional use patterns as some pesticides, which are no longer used, have been deleted and some pesticides have been added. Pesticides previously listed have been deleted if they were known to be discontinued.

All pesticides are presented in alphabetical order, by common active ingredient name only. In some cases, either a trivial name or the chemical name is used in place of a common name. Common and usual trade names for each pesticide are cross-indexed.

For each pesticide, information was collected on the following possible categories, however information may not be comprehensive for each element and is identified as such:

- trade names and manufacturers/registrants

  NOTE: trade names of products with expired registration have been included in *italics*;
- chemical name and Chemical Abstract Services (CAS) registration numbers;
- type of compound and mode of action;
- recent information on the registration and use status of that active ingredient in Canada and or the United States;
- use patterns, including application procedures and rates;
- suggested aquatic set backs:
  - the most restrictive set backs, determined by calculation or as suggested by the Pest Management Regulatory Agency (PMRA) label recommendations, have been provided;
  - calculated set backs for ground and airblast applications were derived using a PMRA Excel Workbook;
  - calculated aerial and forestry set backs were derived using the mathematical AgDRIFT™ model;
  - label suggested set backs were extracted from the individual product labels provided through the PMRA;
  - set backs have been derived for the appropriate application method and vary depending upon percent of active ingredient in products;
  - refer to the Calculated and Label Suggested Aquatic Set Backs Appendix, page 372, at the end of this document, for parameters used in calculated and AgDRIFT™ suggested aquatic set backs;
- storage stability;
- handling precautions;
- environmental persistence;
- toxicity;
- metabolism;
- suggested aquatic set backs; and
- references.

References

All chemical names are those accepted by the International Union of Pure and Applied Chemistry (IUPAC) and/or Chemical Abstracts (C.A.). Additional references included for some pesticides were obtained from the previous compendium and are not numbered for citation. Much of the information included is derived from ten major references, and for brevity these are cited throughout by the following abbreviations:

AC:	Thomson, W.T. Agricultural Chemicals. (Books I-IV) 1985-86 Revision. Thomson Pub., 1985.
CESARS:	Chemical Evaluation Search and Retrieval System (database). Chem Source Database. Canadian Centre for Occupational Health and Safety (CCOHS), Hamilton, ON. 1998.
ECOTOX:	U.S. Environmental Protection Agency, 2002. ECOTOX User Guide: ECOTOXicology Database System. Version 2.0. Available: http:/www.epa.gov/ecotox/. Retrieval October, 2002.
FCH:	Sine, C. (ed.). Farm Chemicals Handbook '90. Meister Publishing Co., 1990.
HH:	Beste, C.F. Herbicide Handbook of the Weed Science Society of America. 5th Ed. Weed Science Society of America, Illinois, 1983. 515 pp.
HSDB:	Hazardous Substances Data Bank (database). National Library of Medicine. Bethesda, MD, USA. 1998.
IH:	MacKay, D., and W. Shui. Illustrated Handbook of Physical – Chemical Properties and Environmental Fate of Organic Chemical. Boca Raton, Florida, Lewis Publishers. 2000.
PM:	Tomlin, C. The Pesticide Manual — Incorporating the Agrochemicals Handbook. 10th Edition, The British Crop Protection Council and The Royal Society of Chemistry. 2000. 1250 pp.
PMRA:	Pest Management Regulatory Agency. 2000. Regulatory Information on Pesticide Product (RIPP) database.
PP:	Kamrin, M.A. (ed.). Pesticide Profiles. Toxicity, Environmental Impact and Fate. Lewis Publishers. 1997.
RIPP:	Regulatory Information on Pesticide Products (database). Chem Source Database. Canadian Centre for Occupational Health and Safety (CCOHS), Hamilton, ON. 1998.

The abstracting journals used in literature search include:

Agricola
Applied Ecology Abstracts
Bibliography of Agriculture
Biological Abstracts
Chemical Abstracts
Ecological Abstracts
Index Medicus
Pesticides Abstracts

Information on uses, rates and methods of application has been collected from several sources. Use pattern information has been verified through the Canadian Centre for Occupational Health and Safety's Chem Source database. However, the information may not necessarily be applicable to the Atlantic region. For full information on usage patterns registered under the authority of the Pest Control Products Act, Health Canada's Pest Management Regulatory Agency (PMRA) must be consulted. (http://www.hc-sc.gc.ca/pmra-arla)

This volume is intended as a ready reference source rather than an authoritative text. The information for each chemical is far from comprehensive as many data gaps exist in the literature for certain actives and data records were not always exhaustive. The compendium information is subject to modification with changing use patterns, application rates, regulatory status and as new research findings are published. The Environmental Protection Branch will attempt to update the compendium on a regular basis.

Queries concerning this compendium should be directed to:

Environment Canada Library, Atlantic Region
5th Floor, Queen Square
45 Alderney Drive
Dartmouth, Nova Scotia
B2Y 2N6
E-mail: library@ec.gc.ca

Préface

La présente mise à jour du Registre des Pesticides est la sixième révision du document original élaboré en 1981 par la Branche de la protection environnementale d'Environnement Canada, région de l'Atlantique.

La liste des produits chimiques qui a servi de base à l'élaboration de ce Registre a été compilée à partir des données cueillies sur les ventes des pesticides en 2001. La présente édition est une version actualisée qui réflète les modes d'utilisation des pesticides dans la région, car certains pesticides, qui ne sont plus utilisés, ont été expurgés et certains ont été ajoutés.

Tous les pesticides sont présentés en ordre alphabétique et uniquement sous leurs noms communs. Dans certains cas, on a utilisé soit un nom insignifiant, soit le nom chimique à la place du nom commun. Le nom commun et le nom commercial de chaque pesticide sont recoupés en l'index.

Pour chaque pesticide, des renseignements ont été fournis dans les catégories possibles suivantes, pourtant cette information peut ne pas être exhaustive pour chaque élément et est identifiée ainsi:

- Les noms commerciaux et les fabricants/ détenteurs d'enregistrement NOTA BENE: Les noms des produits dont l'inscription est expirée ont été ajoutés en *italiques;*
- Le nom chimique et les numéros d'immatriculation des CAS (Chemical Abstract Services);
- Le type de dérivé et le mode d'action;
- Des informations récentes sur l'inscription et la mode d'utilisation de cette matière active au Canada et/ou aux États-Unis;
- Les modes d'utilisation, comprenant les modes et les vitesses de réaction;
- Les retraits aquatiques proposés:
    - Les retraits les plus restrictifs, déterminées mathématiquement ou suivant les recommandations d'étiquettes de l'Agence de réglementation de la lutte antiparasitaire (ARLA) ont été fournis;
    - Les retraits calculés pour les applications au sol ou dans l'air ont été dérivées grâce à un manuel d'instruction Excel de l'ARLA;
    - Les retraits forestiers et aériens ont été dérivés à partir du modèle mathématique AgDRIFT;
    - Les retraits proposés pour les étiquettes ont été pris des étiquettes de chaque produit pris individuellement, étiquettes fournies par l'ARLA;
    - Les retraits ont été dérivés pour la méthode d'application appropriée et pourraient varier dépendant du pourcentage de matières actives présentes dans les produits;
- Veuillez consulter la page 372, Calculated and Label Suggested Aquatic Set Backs Index, pour les paramètres utilisés dans la détermination des retraits aquatiques calculés et proposés grâce au modèle mathématique AgDRIFT;
- La stabilité du stockage;
- Les précautions de manutention;
- La persistence dans l'environnement;
- La toxicité;
- Le métabolisme;
- Les retraits aquatiques proposés; et
- Les références.

Références

Tous les noms chimiques utilisés sont ceux qui sont agréés par le Syndicat internationale de chimie pure et appliquée (LPAC) et/ou par Chemical Abstracts (C.A). Les références supplémentaires inclues pour certains pesticides ont été obtenues du registre de pesticides précédent et ne sont pas numérotées pour les citations. La majorité des informations contenues dans le présent registre provient de 10 (dix) sources principales, et pour la brièveté, celles-ci sont citées partout dans ce document par les abréviations suivantes:

AC:	Thomson, W.T. Agricultural Chemicals. (Books I-IV) 1985-86 Revision. Thomson Pub., 1985.
CESARS:	Chemical Evaluation Search and Retrieval System (database). Chem Source Database. Canadian Centre for Occupational Health and Safety (CCOHS), Hamilton, ON. 1998.
ECOTOX:	U.S. Environmental Protection Agency, 2002. ECOTOX User Guide: ECOTOXicology Database System. Version 2.0. Available: http:/www.epa.gov/ecotox/. Retrieval October, 2002.
FCH:	Sine, C. (ed.). Farm Chemicals Handbook '90. Meister Publishing Co., 1990.
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HSDB:	Hazardous Substances Data Bank (database). National Library of Medicine. Bethesda, MD, USA. 1998.
IH:	MacKay, D., and W. Shui. Illustrated Handbook of Physical – Chemical Properties and Environmental Fate of Organic Chemical. Boca Raton, Florida, Lewis Publishers. 2000.
PM:	Tomlin, C. The Pesticide Manual Incorporating the Agrochemicals Handbook. 10th Edition, The British Crop Protection Council and The Royal Society of Chemistry. 1994. 1341 pp.
PP:	Kamrin, M.A. (ed.). Pesticide Profiles. Toxicity, Environmental Impact and Fate. Lewis Publishers. 1997.
RIPP:	Regulatory Information on Pesticide Products (database). Chem Source Database. Canadian Centre for Occupational Health and Safety (CCOHS), Hamilton, ON. 1998.

Les bulletins d'analyse ayant servi dans la recherche bibliographique sont entre autres:

Agricola
Applied Ecology Abstracts
Bibliography of Agriculture
Biological Abstracts
Chemical Abstracts
Ecological Abstracts
Index Medicus
Pesticides Abstracts

Les informations relatives aux utilisations, aux vitesses de réaction et aux méthodes d'application ont été cueillies de plusieurs sources. Les informations concernant les modes d'utilisation a été vérifiée par la banque des données (Chem Source databank) du Centre canadien d'hygiène et de sécurité au travail. Pourtant, il est possible que toutes ces informations ne s'appliquent pas à la région atlantique. Pour les informations complètes sur les modes d'utilisation agréés par la Loi sur les produits antiparasitaires, l'Agence de réglementation de la lutte antiparasitaire (ARLA) de Santé Canada, veuillez consulter l'adresse suivante: (http://www.hc-sc.gc.ca/pmra-arla)

Le présent volume doit être utilisé comme outil de référence ponctuel et non comme document faisant autorité. Les informations proposées pour chaque produit sont loin d'être exhaustives, d'autant plus que la littérature disponible sur certains actifs comporte plusieurs lacunes au niveau des données étudiées. C'est pourquoi les informations contenues dans ce registre sont susceptibles de modification en fonction des changements relevés dans les modes d'utilisation, les taux d'application, les statuts de réglementation et suivant les nouvelles trouvailles de la recherche. Aussi la Branche de la protection environnementale d'Environnement Canada s'évertuera-t-elle à le mettre régulièrement à jour.

Pour toute les questions au sujet de ce registre des pesticides, veuillez contacter:

Bibliothèque d'Environnement Canada, Région de l'Atlantique
5ème étage, Queen Square
45 Alderney Drive
Dartmouth, Nova Scotia
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E-mail: library@ec.gc.ca

Acknowledgments

Environment Canada wishes to recognize the contributions made to this update of the *Compendium of Information on Pesticides Used in Atlantic Canada.*

Dr. Robert Mickle of REMSpC Consulting provided calculated and AgDrift™ model calculations for suggested aquatic set backs and his input is greatly appreciated.

Gary Julien, Linda Prang and Deanna Brewster, all with Environment Canada were instrumental in the revision and updating of the provided information. Their efforts reflect changes in registration and usage patterns of active ingredients used in the Atlantic region as of 2004.

Products Which Have Been Deleted From Previous Compendiums

Product	Use/Reason For Deletion
Aldicarb	Insecticide - Not eligible for registration as of 1996. No longer used in region.
Allyl Alcohol	Herbicide - Not a registered active ingredient. Last product suspended in 1985.
Aminocarb	Insecticide - Discontinued by registrant December 31, 2000.
Asulam	Discontinued by registrant December 2002.
Benazolin	Herbicide - Discontinued by registrant December 31, 2000.
Captafol	Wood preservative - Cancelled in 1990.
Chloramben	Herbicide - Not eligible for registration as of 1980.
Chlordane	Insecticide - Suspended in 1985.
Chlorfenac	Herbicide - Not eligible for registration as of 1990.
Chlorfenvinphos	Insecticide - Discontinued by registrant December 31, 2000.
Chloroxuron	Herbicide - Discontinued by registrant in 1990.
Crotoxyphos	Insecticide - Discontinued by registrant December 31, 2000.
Cyhexatin	Insecticide - Cancelled in 1989.
Dalapon	Herbicide - Not eligible for registration, discontinued by registrant in 1990.
Demeton	Insecticide - Discontinued by registrant. Not eligible for registration as of 1990.
Dichlone	Fungicide - Discontinued by registrant December 31, 2001.
Dikar	Fungicide/acaricide - Not registered in Canada. Refer to dinocap and maneb.

Dinoseb	Herbicide - Registration expired December 31, 2000.
Dioxabenzofos	Insecticide - Active ingredient not registered in Canada.
Diphenamid	Herbicide - Discontinued by registrant in 1990.
Endrin	Insecticide - Discontinued by registrant in 1990.
Fenaminosulf	Fungicide - Discontinued by registrant in 1990.
Fensulfothion	Insecticide/nematicide - Discontinued by registrant December 31, 2000.
Fluridone	Herbicide - Active ingredient not registered in Canada.
Imazaquin	Herbicide - Active ingredient not registered in Canada.
Methidathion	Insecticide - Registration expired December 31, 2002.
Mevinphos	Insecticide/acaricide - Active ingredient not registered in Canada.
Pentachlorophenol	Discontinued by registrant. Existing stocks only for heavy duty wood preservative.
Phenylmercury acetate	Fungicide - Discontinued in 2000.
Propargite	Discontinued by registrant December 2002.
TCA	Herbicide - Discontinued by registrant December 31, 2002.
Tebuthiuron	Herbicide - Discontinued by registrant December 31, 2000.
Terbuthylazine	Herbicide - Discontinued by registrant in 1990.
Terbutryn	Herbicide - Discontinued by registrant in 1985.
Triadimefon	Fungicide - Temporary registration expired in 1995.

Glossary

a.e.	Acid equivalent (active ingredient expressed in terms of parent acid)
a.i.	Active ingredient
AChE	Acetylcholinesterase. Enzyme that hydrolyzes the neurotransmitter acetylcholine during synaptic nerve impulse transmission.
ACS	American Chemical Society
ADI	Acceptable daily intake. The amount of a substance that can be consumed (from all sources) by an adult on a daily basis, over the course of a lifetime, without a significant increased risk to health.
AG	Aktiengesellschaft (Company)
ANSI	American National Standards Institute
BAN	British Approved Name
BCF	Bioconcentration factor. A measure of a compound's ability to accumulate in a plant or animal, at concentrations higher than are found in the ambient environment. Expressed as a unitless ratio of the compound's concentration in the organism at equilibrium to the compound's concentration in the organism's water or food supply.
BPC	British Pharmacopoeia Commission
BSI	British Standards Institution
b.w.	Body weight
CAS	Chemical Abstracts Services
ChE	Cholinesterase; **see AChE**
CNS	Central nervous system
Corp.	Corporation
Cu	Copper
d	Day(s)
DP	Dustable powder
DS	Powder for dry seed treatment
DT_{50}	Time required for a compound to be reduced to 50% of its original concentration in a specific medium; **see t ½**. Similarly, **DT90** represents the amount of time required for 90% loss.
DU	Dust or powder
DV	Device
E-ISO	ISO name (english); **see ISO**
EC	Emulsifiable concentrate or emulsion
EC_{50}	Effective concentration, 50. The median concentration of a substance, expressed in µg/L, mg/L, ppm, etc., that results in a specified biological effect in 50% of a target population. Usually derived from laboratory experiments of specific exposure time (*e.g.* 48 hours).
EPA	**see USEPA**
ESA	Entomological Society of America
et al.	And others (authors)
FAO	Food and Agricultural Organization (of the United Nations)
F-ISO	ISO name (French); **see ISO**
F.T.	Feeding trial
g	Gram(s) (hence also µg, mg, kg, etc.)
GABA	Gamma aminobutyric acid. Amino acid neurotransmitter. More abundant than any other neurotransmitter in the brain.
GR	Granular
h	Hour(s)
ha	Hectare(s) ($10000m^2$)
HN	Hot fogging concentrate
IF	Impregnated fabric
IPN	International Proprietary Name
i.p.	Intraperitoneal; **see LD50**
ISO	International Standardization Organization
Kg	Kilogram(s)
K_{oc}	Adsorption coefficient. The tendency of a material to absorb to soil particles. Koc values of less than 500 indicate little or no absorption and a potential for leaching.
L	Litre(s) (hence also ml,µl, etc.)

LC_{50}	Lethal concentration, 50. Median effective concentration of a substance required to kill 50% of a target population, expressed as ppm, ppb, mg/m^3, mg/L, etc. Usually derived from laboratory experiments, a defined route of administration and an exposure period is often indicated (*e.g.* LC50 inhalation 4h, LC50 96h).
LD_{50}	Lethal dose, 50. Median effective dose of a substance required to kill 50% of a target population. Similar to **LD100**, where the dose is required to kill 100% of the population. Often expressed as the mass of the substance per mass of the subject organism, a time period or route of administration is often specified (LD50 oral, LD50 topical, LD50 dermal).
LI	Liquid
LOEC	Lowest observed effect concentration. The lowest concentration in a toxicity study that results in a specific effect in the target organism.
LOEL	Lowest observed effect level. The lowest dose in a toxicity study that results in a specific effect in the target organism.
m	Metre(s) (hence also mm, km, etc.)
mg	Milligram(s), 10^{-3} (0.001) g
MLD	Minimum lethal dose. The smallest of several doses which kills one of a group of test animals.
mm	Millimetre(s), 10^{-3} (0.001) m
MS	Microencapsulated suspension
NADPH	Reduced form of the molecule nicotinamide adenine dinucleotide phosphate. Acts as an electron carrier during photosynthesis.
NEL	**see NOEL**
NOAEL	No observed adverse effect level. The highest dose in a toxicity study that does not result in an observed adverse effect on the target organism. An adverse effect is one that alters the health or reduces the survival of the target organism.
NOEC	No observed effect concentration; **see NOEL**.
NOEL	No observed effect level. The highest dose in a toxicity study at which no biologically significant increase in frequency or severity of an effect is observed. Similar to **NOEC**, where a concentration is measured.
NRDC	National Research and Development Corporation
o.m.	Organic matter
OP	Organophosphate
PA	Paste
PADI	Provisional acceptable daily intake; **see ADI**
PE	Pellets
pH	A unitless index of hydrogen ion activity, the pH represents the negative logarithm of hydrogen ion concentration (in moles per litre), and can range from 0-14.
PMDI	Provisional maximum daily intake
PMRA	Pest Management Regulatory Agency
PP	Pressurized product
PT	Particulate
QSAR	Quantitative structure-analysis relationship. A system of models used to predict toxicity parameters, physical properties, and the environmental fate of substances based on chemical structure. Often used when experimental or laboratory data are lacking.
RB	Bait (ready-to-use)
RBC	Red blood cell
SC	Suspension concentrate
SG	Soluble granules
SL	Soluble concentrate
SN	Solution
SO	Solid
SP	Soluble powder
spp.	Subspecies. A clearly defined, morphologically distinct, named geographic variety of a species.
SR	Slow-release generator
SU	Suspension

t ½	Half-life. Time required for a chemical to reach 50% of its original concentration. Varies according to the environmental medium (air, water, soil), temperature, the availability of oxygen, etc. Usually measured in days (d) or hours (h).
TA	Tablet
tech.	Technical grade
TL_{50}	**see TLm**.
TLm	Tolerance concentration, median. The median concentration of a substance that results in the survival of 50% of a test population of organisms. An administration route and an exposure period are usually defined. Used interchangeably with **TL50**.
USA	United States of America
USEPA	United States Environmental Protection Agency
WG	Wettable granules
WHO	World Health Organization (of the United Nations) = OMS
WP	Wettable power
WSSA	Weed Science Society of America
y	year(s)

Abamectin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — abamectin (BSI, draft E-ISO, ANSI), abamectine (draft F-ISO)

[ii] TRADE NAME — Agri-Mek, Avid, Dynamec (Merck-Agvet)

[iii] CHEMICAL NAME — avermectin B1a

[iv] CAS # — 71751-41-2

[v] TYPE/MODE OF ACTION — Abamectin is a mixture of two antibiotic compounds (~80% avermectin B1a, ~20% avermectin B1b) derived from a soil bacterium, *Streptomyces avermitilis*. Contact and stomach insecticide; stimulates the release of an inhibitory neurotransmitter to cause paralysis.[1]

2. USE PATTERN

Miticide/insecticide used to control pests of pear, apple, citrus, greenhouse ornamentals, potatoes. Also used to control fire ants.[4]

[i] APPLICATION — FIELD: Apply using dilute or concentrate ground sprayers, with at least 10 L/ha paraffinic oil in concentrated sprays. Avoid applying within 35 m upwind from aquatic areas. Avoid aerial application.[4]
GREENHOUSES: Apply as foliar spray when insects appear.[3]

[ii] RATES — FIELD CROPS, 13.5-30 g a.i./ha in 3750 L water. ORNAMENTALS, 10.8-21.6 g a.i./ha in 1000-4000 L water.[3]

CARRIER: Paraffinic oil.

[iii] FORMULATIONS

1. EC
2. RB

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 19.3 m
2. Air blast application: Calculated: (29.1) 19.8 m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store in a cool, dry place. Do not contaminate water, food or feed by storage or disposal. Do not reuse empty container.[3]

4. HANDLING PRECAUTIONS

Do not apply within 28 days of harvest. Can cause severe but temporary eye injury. Avoid contact with skin, wash thoroughly with soap and water after handling, before eating or drinking.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Binds tightly to soil and is rapidly degraded by microbes. Half-life 2-8 weeks under dark, aerobic conditions. Rapid photodegradation at soil surface. Unlikely to leach or contaminate groundwater.[4]

[ii] AQUATIC — Rapid degradation. Half-life 12 hours.[4]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION — No absorption from soil. Metabolites are non-toxic.[1]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	10.0 mg/kg		1
Rat	LD_{50} oral	650 mg/kg	Avid EC	2
Rabbit	LD_{50} dermal	>330 mg/kg	Technical grade abamectin	4
Bobwhite quail	LD_{50} oral	>2000 mg/kg		1
Mallard	LD_{50} oral	84.6 mg/kg		1
Rainbow trout	LC_{50} 96h	0.003 mg/L		4
Bluegill sunfish	LC_{50} 96h	0.0096 mg/L		1
Carp	LC_{50} 96h	0.042 mg/L		4
Blue crab	LC_{50} 96h	153 mg/L		4
Pink shrimp	LC_{50} 96h	0.0016 mg/L		4
Daphnia magna	*EC_{50} 48h*	*0.0034 mg/L*		*1*

[i] TOXICITY (OTHER) — Slight primary skin irritation.[2] Not carcinogenic to rats or mice.[4] Highly toxic to bees (LD_{50} oral 0.009 µg/bee).[4]

[ii] PHYTOTOXICITY – May be phytotoxic to pome fruit when mixed with captan.[1] Phytotoxic to certain species of ferns and Shasta daisies.[3]

7. METABOLISM

[i] ANIMAL - Not readily absorbed into bloodstream and rapidly eliminated in mammals. Average half-life of avermectin B1a in rat tissue is 1.2 days.[2] Not bioaccumulative.[1]

[ii] PLANT – Degradation/metabolism occurs predominantly by photolysis on plant surfaces.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. PMRA
4. PP

Acephate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — acephate (BSI, E-ISO, F-ISO, ANSI, ESA, JMAF)

[ii] TRADE NAME — Orthene (Arvesta Corporation); *Ace Cap 97 (Creative Sales Inc.)*

[iii] CHEMICAL NAME — *O,S*-dimethyl acetylphosphoramidothioate

[iv] CAS # — 30560-19-1

[v] TYPE / MODE OF ACTION — An organic phosphate used as a contact and systemic insecticide and acaricide. Inhibits cholinesterase.

[vi] NOTICE — Acephate is **currently under re-evaluation** in Canada with a decision expected in late 2003. The US EPA issued cancellation and use deletions of all acephate products registered by seven registrants, Valent USA Corporation, Micro Flo Company LLC, Drexel Chemical Company, United Phosphorus, Inc., Whitmire Micro-Gen Research Labs, The Scotts Company, and Pursell Technologies, Inc. The cancellations, effective March 6, 2002, were requested to reduce residential risks, including risks to children.

2. USE PATTERN

For the control of aphids, thrips, grasshoppers, loopers, budworms, leaf miners, gypsy moths, cabbage worms and others. Used on ornamental trees, beans, tomato, celery, cranberries, grasses, lettuce, peppers, pastures, tobacco, shrubs, and roses.[3]

[i] APPLICATION — Apply when insects appear and repeat as necessary.[3] Remains effective for extended time period as it is absorbed systemically by plants. [4] May be applied with either a Hydraulic or a Mistblower sprayer. Aerial treatments may also be used. Also used in implant cartridges for birch, elm, oak, etc.

[ii] RATES — Cole crops, 0.56–0.825 kg a.i./ha in 225-1000 L water. Forest products, 0.64-1.32 kg a.i./1000 L water, 0.875 g a.i./cartridge.[3]

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. DU
3. SP
4. SN
5. SO
6. IS

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 10 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Label: implant cartridges only, not sprayed

3. STORAGE

Relatively stable.[5] Store in a cool, dry place. Protect from excessive heat.

4. HANDLING PRECAUTIONS

Avoid spray drift.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Moderately persistent. Soil half-life ranges from 3-6 days. [2] May leach readily in soil (K_{oc} 2-8). [5]

[ii] AQUATIC — In a helicopter-spray study, post-spray residues peaked in a stream within an hour after application (140 μg/L) and disappeared at about 40%/day.[6]

[iii] ATMOSPHERIC — Estimated half-life 6 months. Removal by photo-oxidation.[5]

[iv] PHYTODEGRADATION — Residual activity lasts for roughly 10-15 days. Major metabolite is methamidiphos.[1]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	866 mg/kg	Female rat, technical grade	2
Rat	LD_{50} oral	945 mg/kg	Male rat, technical grade	5
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Dog	LD_{50} oral	>681 mg/kg		1
Human	ADI	0.03 mg/kg		1
Mallard	LD_{50} oral	350 mg/kg		2
Coturnix Quail	LC_{50} oral 5d	3275 ppm		5
Ringnecked pheasant	LD_{50} oral	140 mg/kg		1
Rainbow trout	LC_{50} 96h	1100 μg/L	Static bioassay w/o aeration	5
Bluegill	LC_{50} 96h	1000 μg/L	Static bioassay w/o aeration	5
Largemouth bass	LC_{50} 96h	1725 mg/L		1
Channel catfish	LC_{50} 96h	2230 mg/L		1
Sheepshead minnow	LC_{50} 96h	>3200 mg/L		6
Pink shrimp	LC_{50} 96h	>10.0 mg/L		6

[i] TOXICITY (OTHER) — Toxic to bees (LD_{50} 1.2 μg/bee).[1] Non-teratogenic, non-mutagenic and non-carcinogenic.[1] High levels in rats result in a significant elevation of plasma epinephrine and a decrease in levels of GABA, dopamine and tyrosine. It also causes an inhibition of brain AChE and ChE.[7] Not expected to bioconcentrate in aquatic organisms (BCF 0.1-0.3).[5]

[ii] PHYTOTOXICITY — Marginal leaf burn may occur on Red Delicious apples. Do not apply to American Elm, Sugar Maple, Cottonwood or Redbud.[4]

7. METABOLISM

[i] ANIMAL - Enzymes inhibited by acephate in the rat begin to recover after 24 hours and the chemical was completely eliminated within 3 days.[3] In animals, metabolized to methamidiphos.[1]

[ii] PLANT – Residual acitivity lasts for c. 10-15 days. The major metabolite is methamidophos.[1]

8. ADDITIONAL INFORMATION

This substance appears to have a lesser impact on a forest stream than other spruce-budworm insecticides.[6]

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. Acephate, aldicarb, carbophenothion, DEF, EPN, ethoprop, methyl parathion and phorate: Their acute and chronic toxicity, bioconcentration potential and persistence as related to marine environments (1981) Experimental Environments Branch, Environmental Research Laboratory, U.S. EPA, Gulf Breeze, FA 32561.
7. Singh, A.K. and L.R. Drewes (1987) Neurotoxic effects of low-level chronic acephate exposure in rats. *Environ. Res.*, 43:342-349.

Allethrin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — allethrin (BSI, E-ISO, ESA, JMAF); allethrine (F-ISO); pallethrine (France); exception (FRG)

[ii] TRADE NAME — Pynamin (Sumitomo Chemical Co.). Manufacturers: Sumitomo Chemical Co., McLaughlin Gormley King Co.

[iii] CHEMICAL NAME — (*RS*)-3-allyl-2-methyl-4-oxocyclopent-2-enyl (1*RS*,3*RS*; 1*RS*,3*SR*)-2,2-dimethyl-3-(2-methylprop-1-enyl) cyclopropanecarboxylate.

[iv] CAS # — 584-79-2

[v] TYPE / MODE OF ACTION— Synthetic pyrethroid insecticide and acaricide with contact, stomach poison and fumigant action.

[vi] NOTICE — Allethrin has **no registered food uses in Canada**. The only registrations are for mosquito coils. In March of 2002, US EPA proposed to revoke several tolerances for residues of allethrin as the pesticide is no longer registered for associated food uses in the United States.

2. USE PATTERN

This contact insecticide is as effective as natural pyrethrins against houseflies but less effective against household pests and most other insects. Its activity is enhanced by pyrethrin synergists though less markedly by piperonyl butoxide. Used only for fly and mosquito control.

[i] APPLICATION — Used only in mosquito coils.

[ii] RATES — 0.04 g a.i./mosquito coil.

CARRIER: Aerosols.

[iii] FORMULATIONS

1. Various, often with synergists, including SO, PP.
2. Aersols
3. Coils

[iv] SUGGESTED AQUATIC SET BACKS

4. Ground application: Calculated: 30 m
5. Air blast application: Not identified.
6. Aerial application: Not identified.
7. Forestry application: Not identified.

3. STORAGE

Chemical properties similar to pyrethrins. Ineffective in alkaline solutions. Store in closed drum in cool, dry, well ventilated area.[2]

4. HANDLING PRECAUTIONS

Not compatible with Bordeaux mixture, calcium arsenate, lime, lime sulphur, soaps, lead, brass, copper, zinc, or iron.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL - Somewhat more persistent than pyrethrins. Rapidly broken down by sunlight.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1100 mg/kg	Male rats	5
Rat	LD_{50} oral	585 mg/kg	Female rats	1
Rat	NOEL 1 y F.T.	2000 mg/kg diet	No ill-effects	1
Rabbit	LD_{50} oral	4290 mg/kg		5
Dog	2 y F.T.	50.0 mg/kg/d	No detectable effect	5
Bobwhite quail	LD_{50} oral	2030 mg/kg		1
Mallard	LD_{50} oral	>2000 mg/kg		5
Steelhead trout	LC_{50} 96h	17.5 mg/L		1
Rainbow trout	LC_{50} 96h	9.7 µg/L		6
Coho salmon	LC_{50}	0.0026 mg/L	D-allethrin	5
Channel catfish	LC_{50} 96h	30.0 mg/L		1

[i] TOXICITY (OTHER) — Low toxicity to mammals. Some people develop an allergy. No food additive tolerances exist for use in food processing or warehouses or for meats or milk animals. Exempt from tolerances on agricultural crops. Tolerances exist for several post-harvest uses. Very toxic to cold-blooded animals. Slightly toxic to bees (LD_{50} 0.003-0.009 mg/bee).[5]

[ii] PHYTOTOXICITY - Non-phytotoxic.

7. METABOLISM

[i] ANIMAL - Similar to pyrethrins. Following oral administration in mammals, allethrin is broken down by oxidation of a terminal methyl group.[1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Allyl homologue of Cinerin 1 which is a synthetic analogue of one of the 4 toxic constituents of pyrethrins.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. PP
6. ECOTOX

Amitrole

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — amitrole (BSI, E-ISO, F-ISO, ANSI, WSSA); ATA (JMAF); aminotriazole (France)

[ii] TRADE NAME — Amizol, Amitrol-T, Allizol (CFPI Agro); Later's Calcide (Later Chem. Ltd.); *Amizine (Rhone Poulene Can. Inc.).*

[iii] CHEMICAL NAME — 1*H*-1,2,4-triazol-3-ylamine; or 3-amino-1*H*-1,2,4-triazole.

[iv] CAS # — 61-82-5

[v] TYPE / MODE OF ACTION— Non-selective systemic triazine herbicide: combination of aminotriazole and ammonium thiocyanate. Absorbed by leaves and roots, inhibits chlorophyll formation and regrowth from buds.[1]

2. USE PATTERN

Post-emergence translocated non-selective herbicide particularly useful for controlling many perennial and annual broadleaf and grass weeds on non-cropland, food/feed crops, and outdoor living areas. Useful against quack grass, horsetail, poison ivy, milkweed, Canada thistle and cattails. Used on a 'no residue' basis, it controls grass and weeds in cranberries.

[i] APPLICATION — May be applied to soil or foliage. Treat after leaves are fully developed. Thoroughly cover foliage without loss by runoff, on vigourously growing weeds. If possible, apply before weeds are 12-15 cm high. Poor results have occurred on drought-stressed or over-mature weeds. Heavy rains following application will reduce effectiveness.

[ii] RATES — 2.24-11.2 kg/ha; 1.1-22.4 kg actual/ha in 136-1360 L water [1]; 325-500 mL/10-100m^3 in 2.5 - 10.0 L water; 50–2000 g a.i./100m^2; 2.1 – 10.0 kg a.i./ha.

CARRIER: Water, 93 to 1870 L/ha; water soluble.

[iii] FORMULATIONS

1. SP
2. LI
3. PP
4. SU
5. SN

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 0 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Mostly non-flammable. Mildly corrosive to iron, aluminum, copper and copper alloys. No shelf life limitations. When exposed to light, breaks down to CO$_2$, urea and cyanamide.[7]

4. HANDLING PRECAUTIONS

Most crops are sensitive to spray. Used in mixtures with more persistent herbicides for general weed control in non-crop areas; not intended for mixing with other pesticides and fertilizers. Do not use on feed crops. Keep livestock out of treated areas. Harmful if swallowed. Avoid contact with skin, eyes, clothing.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL —Persists in soil for c. 2-4 weeks.[1] Loss of soil is principally by microbial breakdown.[1] Breakdown products (CO$_2$, urea, cyanamide) should be readily metabolized.[7]

[ii] AQUATIC — Reported half-life of >40 days in water.[9] Ponds treated with 0-45 mg/L showed slow decline (46 days to limit of detection).[2] At 1.0 mg/L detectable levels persisted to 201 days.[2]

[iii] ATMOSPHERIC — UV light can cause ring opening to form (N$_2$) urea and cyanamide.[7]

[iv] PHYTODEGRADATION — Good translocation. Readily metabolized. Glycine and serine used in bio-synthesis of B-(3 amino-s-triazolyl-1)-a-alanine. Metabolic pathways appear very complex. No single mode of action in plants.[7]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1100-24,600 mg/kg		1
Rat	476 d F.T.	50 mg/kg diet	No effect on growth or food intake. Males developed enlarged thyroid.	1
Rabbit	LD_{50} dermal	>200 mg/kg		5
Rabbit	LD_{50} 24h	10,000 mg/kg	No deaths or symptoms of systemic activity	2
Dog		0.025 mg/kg/d	No effect level	6
Dog		12.5 mg/kg/d	No effect level	6
Human	ADI	0.0005 mg/kg b.w.		1
Mallard	LD_{50}	2000 mg/kg		5
Rainbow trout	LC_{50} 96h	>180 mg/L		10
Cyclops vernalis	*LD_{50} 48h*	*58.5 µl/L*		*8*
Cyclops vernalis	*LD_{50} 96h*	*22.1 µl/L*		*8*

[i] TOXICITY (OTHER) — Not toxic to fish or wildlife when used as recommended. 3 mg of acid produced mild eye irritation to rabbit for 48h Minimal Dermal Irritation. Two year lifetime rat studies indicate that amitrole is a goitrogen. No evidence of systemic toxicity. This compound is non-mutagenic [4] and apparently non-carcinogenic. Mild eye irritant.

[ii] PHYTOTOXICITY — Most crops if contacted by spray are sensitive.

7. METABOLISM

[i] ANIMAL – Affects various biochemical systems including catalases, peroxidases and certain enzymes involved in oxidative metabolism. Rapidly absorbed and eliminated primarily in urine. Conjugates formed with sugars and proteins.[6] Elimination from all tissues rapid; average half-life for clearance is 4.2 hours.[7]

[ii] PLANT – Readily metabolised in plants, with formation of conjugates with endogenous plant constituents.[1]

8. ADDITIONAL INFORMATION

Quickly inactivated in heavy soil so inadequate for root absorption if applied to soil. Older plants absorb amitrole more slowly.

9. REFERENCES

1. PM
2. Meister, R.T. Farm Chemicals Handbook '86. Meister Publishing Co., 1986.
3. AC
4. HH
5. PP
6. Vettorazzi, G. (1977) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO Expert Committee on Pesticide Residues. III. Miscellaneous pesticides used in agriculture and public health. *Residue Reviews*, 66: 137-184.
7. W.H.O. (1975) 1974 Evaluations of some pesticide residues in food. The Monographs. W.H.O. Pesticide Residue Series, No. 4. 545 pp.
8. Robertson, E.B., & D.L. Bunting (1976) The acute toxicity of four herbicides to 0-4 hour nauplii of *Cylcops vernalis* Fisher (Copepoda, Cyclopoida). *Bull. Environ. Contam. Toxicol.* 16: 682-688.
9. Reinert, K.H. and J.H. Rodgers (1987) Fate of aquatic herbicides. *Reviews of Environmental Contamination and Toxicology*, Vol 98: 61-98
10. ECOTOX

Ancymidol

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — ancymidol(BSI, E-ISO, ANSI); ancymidole (F-ISO)

[ii] TRADE NAME — A-Rest (SePRO Corporation)

[iii] CHEMICAL NAME — a-cyclopropyl-4-methoxy-a-(pyrimidin-5-yl)benzyl alcohol.

[iv] CAS # — 12771-68-5

[v] TYPE / MODE OF ACTION— A pyrimidine compound used as a plant growth regulator. Absorbed through both roots and foliage, causing a reduction in internode elongation. This growth inhibition may be reversed by an application of gibberellic acid.[3]

2. USE PATTERN

For growth control of such greenhouse plants as chrysanthemums, poinsettias, daffodils, lilies and tulips. Also effective in the reduction of Fusarium wilt in melons.[4]

[i] APPLICATION — Apply as a soil drench to moist (not wet or recently watered) soil, or as a foliar spray. Do not add any additional wetting agents. Ensure uniform coverage. Apply early in the season and response should be visible in 7-10 days. Split applications are sometimes desirable. Do not apply as a surfactant. CHRYSANTHEMUMS: Apply prior to the end of the second week of induction when plants are 5-15 cm tall. EASTER LILIES: Apply from emergence to 30 cm tall. POINSETTIAS: Treat at pinch to 4 weeks after pinch, or 8-12 weeks before finishing.

[ii] RATES — 0.25-0.50 mg a.i./ 15 cm pot. Mix with water for application.

CARRIER: Not identified.

[iii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Avoid freezing. Store in original container.

4. HANDLING PRECAUTIONS

Avoid contact with skin, eyes, or clothing. Do not contaminate water, food, or feed. Treated plants have a decreased water requirement so care should be taken to avoid overwatering.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Undergoes microbial degradation in soil.[1]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	5000 mg/kg		1
Rat	90 d F.T.	8000 mg/kg diet	Suffered no ill effect	1
Dog	90 d F.T.	8000 mg/kg diet	Suffered no ill effect	1
Rabbit	LD_{50} dermal	200 mg/kg	Very slight skin irritation	2
Chicken	LD_{50} oral	>500 mg/kg		1
Bluegill	LC_{50}	146 mg/L		1
Rainbow trout	LC_{50}	55.0 mg/L		1
Goldfish	LC_{50}	>100 mg/L		1

[i] TOXICITY (OTHER) — Not toxic to bees. Testing for acute toxicity on animals indicates that if inhaled, ingested, or applied to eyes, ancymidol is considered slightly acutely toxic; applied to skin, ancymidol is virtually non-toxic.[5] Not carcinogenic, mutagenic or teratogenic.[1]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.[1]

7. METABOLISM

[i] ANIMAL – Minimal adverse effects to birds mammals and aquatic organisms.[5]

[ii] PLANT – Minimal adverse effects to non-target plants. [5]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Cohen, R., *et. al.* (1987) Paclobutrazol and other plant growth-retarding chemicals increase resistance of melon seedlings to Fusarium wilt. *Plant Pathol.* 36: 558-564.
5. USEPA. 1995. R.E.D. Facts: Ancymidol. Prevention, Pesticides and Toxic Substances. EPA-738-F-95-027, June.

Anilazine

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — anilazine (BSI, E-ISO, F-ISO); triazine (JMAF)

[ii] TRADE NAME — Dyrene (Bayer Inc. Ag. Div.). Other names include Kemate and Direz.

[iii] CHEMICAL NAME — 4,6-dichloro-*N*-(2-chlorophenyl)-1,3,5-triazin-2-amine

[iv] CAS # — 101-05-3

[v] TYPE / MODE OF ACTION — A triazine compound used as a foliar protective fungicide.[3]

[vi] NOTICE — The active anilazine **is being discontinued by the registrant** with the last date of sale being December 15, 2005.

2. USE PATTERN

For the control of important fungal diseases which attack lawns, cereals, vegetables, strawberries, cranberries, and other crops. Also controls anthracnose on blueberries, potato and tomato leafspots, potato blight, rust and snow melt. May be used as a mildew-proofing additive in paints, enamels, lacquers, etc.[3] Used for tobacco and turf treatment.

[i] APPLICATION — Apply uniformly to get good coverage. Repeat at 4-10 day intervals if necessary throughout the summer. Do not use on greenhouse crops. May be applied with Garden Hose Sprayers or Compressed Air Sprayers. Compatible with most insecticides and fungicides, but not with oils and alkaline materials.

[ii] RATES — GENERAL: Apply at 1.6-3.8 kg a.i./ha in 380-1000 L water. BLUEBERRIES: 2.2 kg a.i./ha. LAWN AND TURF: 7.5-12.5 kg. a.i./ha; 62.5-125 ga.i./100m^2.

CARRIER: Water.

[iii] FORMULATIONS

1. WP (only formulation registered in Canada)
2. GR
3. DV

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 12-17 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Store in a cool, dry place.

4. HANDLING PRECAUTIONS

Protective clothing should be worn during all periods of exposure. Anilazine is corrosive to the eyes. This chemical is hazardous to aquatic organisms. Avoid drift and runoff from treated areas. Do not re-enter area within 24 hours of treatment.[4] Stable in neutral and slightly acidic media, hydrolyzed by alkalion heating; incompatible with oils and alkaline material.[5]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Anilazine is rapidly degraded in both moist and dry soils under aerobic conditions, with half-lives of 0.5 and 2.5 days, respectively.[4] It exhibits intermediate mobility in sandy loam and low mobility in agricultural sand, sandy clay loam, silt loam and silty clay soils.[4]

[ii] AQUATIC – Potential for bioconcentration in aquatic organisms is moderate. [5]

[iii] ATMOSPHERIC – Expected to exist solely in the particulate phase in the ambient atmosphere, may be removed by both wet and dry deposition. [5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>4000 mg/kg		1
Rat	NOEL 2 y	2000 mg/kg diet		1
Rat	LD_{50} dermal	>5000 mg/kg		1
Rabbit	LD_{50} oral	460 mg/kg		4
Rabbit	LD_{50} dermal	>9400 mg/kg	intact skin	4
Rabbit	LD_{50} dermal	>2500 mg/kg	abraded skin	4
Dog	LD_{50} oral	>7100 mg/kg	MLD	4
Monkey	LD_{50} oral	>3200 mg/kg	MLD	4
Human	ADI	0.1 mg/kg b.w.		1
Mallard	LD_{50} oral	>5000 mg/kg		1
Virginia quail	LD_{50} oral	>2000 mg/kg b.w.		1
Rainbow trout	LC_{50} 96h	0.15 mg/L		1
Bluegill	LC_{50} 48h	<0.1 ppm		2
	EC_{50} 48h	0.07 mg/L		1

[i] TOXICITY (OTHER) — Toxic to fish and aquatic invertebrates. May cause skin irritation.

[ii] PHYTOTOXICITY - May be phytotoxic to some fruit and ornamentals; overall, non-phytotoxic when used at recommended rates. [5]

7. METABOLISM

[i] ANIMAL – Almost all excreted in urine and faeces within 72 hours.[5]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
5. HSDB

4-AP

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — 4-AP

[ii] TRADE NAME — Avitrol (Avitrol Corp.)

[iii] CHEMICAL NAME — 4-Aminopyridine

[iv] CAS # — 504-24-5

[v] TYPE / MODE OF ACTION— Avi-repellent or toxicant. Causes individuals to utter vocal and physical distress which acts as an area repellent to the remainder of the flock. Only small numbers need to be affected to alarm the rest of flock; birds will not return where they have been treated.

2. USE PATTERN

Bird control. EPA registered in the U.S. for control of crows, pigeons, grackles, starlings, sparrows, cowbirds, gulls and blackbirds in and around structures, airports, agriculture (sunflower, field corn sweet corn).

[i] APPLICATION — Applied as grain baits or powder. Apply bait when birds congregate. Application important since different species have different feeding habits. Pre-baiting often necessary. Repeat if necessary as more birds reappear throughout the year. To cropland, apply evenly in swaths 18 m wide with about 36 m between (about 1/3 of acreage) by air or ground equipment. Repeat after heavy rain or when bait is depleted. A 15.25 m swath should be left around perimeter of field to minimize hazard to game birds.

[ii] RATES – Not identified.

CARRIER: Not identified.

[ii] FORMULATIONS

1. PT

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Shelf life indefinite as long as kept dry.[1] Stable to light.

4. HANDLING PRECAUTIONS

POWDER CONCENTRATES: Use protective gloves and respirator when handling. GRAIN CONCENTRATES: Handle with protective gloves. Contact lenses should not be worn while handling this substance.[4] Wash thoroughly with soap, water after handling all concentrates. Do not overdose or birds will be killed. Do not use in any manner to endanger desirable and protected bird species.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Highly persistent. Half-life ranges from 3 months in clay soil to 32 months in sandy loam soil.[3]

[ii] AQUATIC – If released into water it is not expected to adsorb to suspended solids and sediment in water based upon the estimated K_{oc}.[4]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	20.0-29.0 mg/kg		3
Dog	LD_{50} oral	3.7 mg/kg		3
Mallard	LC_{50} dietary (8d)	722 ppm		3
Bluegill	LC_{50}	3.2-3.4 mg/L		3

[i] TOXICITY (OTHER) – Toxic to birds when eaten in sufficient amounts; danger to birds can be reduced by limiting concentration in baits and amount available to be eaten. This chemical does not cause any secondary poisoning problems.

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Excreted in urine and rapidly detoxified in the liver, thus the flesh of dead birds is not toxic to predatory animals.[4]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Not for sale to general public. Used only by government agencies or licensed pest control operators.

9. REFERENCES

1. FCH
2. AC
3. PP
4. HSDB

Atrazine

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — atrazine (BSI, E-ISO, F-ISO, ANSI, WSSA, JMAF)

[ii] TRADE NAME — Aatrex (Syngenta Crop Protection Canada Inc.); Clean Crop (United Agri Products); Laddok (BASF Canada Inc.); Drexel (Drexel Chemical Co.); Coverge, Liberty (Aventis). *Formula 500 (Rhone Poulene Canada Inc.); Blazine (Dupont Canada Inc.)*

[iii] CHEMICAL NAME — 6-chloro-*N*2-ethyl-*N*4-isopropyl-1,3,5-triazine-2,4-diamine

[iv] CAS # — 1912-24-9

[v] TYPE / MODE OF ACTION — Selective systemic triazine herbicide, absorbed through the roots and foliage with accumulation in apical meristems and leaves. Inhibits photosynthesis and other enzymic processes.[1]

[vi] NOTICE — Atrazine is **currently under re-evaluation** in Canada. Much study is being done on atrazine as it has been shown that exposure at low ecologically relevant doses has been connected with intersexuality in amphibians. Atrazine is thought to interfere with sex differentiation and development in frogs.[9]

2. USE PATTERN

This herbicide is for selective and non-selective control of vegetation. Controls broadleaf and grassy weeds such as lamb's-quarters, wild oats, ragweed, foxtail, purslane in corn, triazine-resistant canola, sorghum, blueberries, sugarcane, macadamia, orchards, pineapple and turfgrass sod and conifer reforestation. As a non-selective control of vegetation in chemical fallow. Compatible with cyanazine, bentazon, metolachlor, and others.[3]

[i] APPLICATION — GROUND: Pre-plant, pre-emergence or post-emergence but before seedlings are more than 30 cm.[3] A shallow incorporation may increase the degree of weed control. Many dry bulk granular fertilizers can be impregnated with atrazine products.[3] AERIAL: Applications in wet weather, rough terrain, forest industry.

[ii] RATES — Corn, Canola, Blueberries, 1.0-1.52 kg a.i./ha.

CARRIER: GROUND: Water, at 112 L/ha. Liquid fertilizers (fertilizers and herbicides in one application), 225 kg/ha. Oil, 5.6-11.0 L/ha. AERIAL: Oil concentrates at 1/4 of the volume of non-phytotoxic oils. Surfactants in post-emergent weed sprays.

[iii] FORMULATIONS

1. WP
2. TA
3. SU
4. GR
5. EC
6. SN
7. WG
8. SO

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Label: 10-15 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Stable over several years of shelf life — with only slight sensitivity to natural light and extreme temperatures which would occur normally.[4] Non-flammable, non-corrosive. Relatively stable in neutral, weakly acidic and weakly alkaline media.[1]

4. HANDLING PRECAUTIONS

Avoid inhalation of dust. Non-compatible with hormome-type weedkillers such as dicamba, MCPA, 2,4-D.

5. ENVIRONMENTAL PERSISTENCE

Will persist longer under conditions not conducive to maximum chemical or biological activity, such as under dry or cold conditions. May move laterally with water; also leaches downwards. On average, 1-3% of field applied atrazine is transported to nearby water bodies and associated watersheds in runoff, irrigation drainage, and spray drift.

[i] SOIL — More readily absorbed on clay or muck soils than on soils of low organic content. Normally not found below upper 30 cm of soil, even after years of continuous use. [2] Downward and lateral movement found in soil. Atrazine is degraded in soil both by phytolysis and microbial processes, with a half life of 60 - >100 days, on average.[6] Microbial activity possibly accounts for decomposition of a significant portion of atrazine in soil. A range of soil microorganisms can use it as energy source.[2]

[ii] AQUATIC — Degradation and sorption of atrazine is very low in aquatic systems. Undergoes rapid hydrolysis in acidic and basic environments but hydrolysis is slow at neutral pH. [6]

[iii] ATMOSPHERIC — Eliminated by vapour phase reactions with hydroxyl radicals (Half life ~ 2.6 h). [4]

[iv] PHYTODEGRADATION — Readily metabolized by tolerant plants to hydroxyatrazine and amino acid conjugates. Unaltered atrazine accumulates in sensitive plants causing chlorosis and death.[2]

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	1869-3080 mg/kg	Technical grade	1
	Rabbit	LD$_{50}$ oral	750 mg/kg	
6				
Rabbit	LD$_{50}$ dermal	7500 mg/kg		1
Dog	NOEL 2y	150 mg/kg diet		1
Mallard	LD$_{50}$ oral	>2000 mg/kg	Females, 80% WP	4
Bobwhite quail	LD$_{50}$ oral	940 mg/kg		1
Pheasant	LD$_{50}$ oral	>5000 ppm		4
Rainbow trout	LC$_{50}$ 96h	4.5-11.0 mg/L		1
Brook trout	LC$_{50}$ 8d	4.1-9.7 mg/L		5
Bluegill	LC$_{50}$ 96h	16.0 mg/L		1
Carp	LC$_{50}$ 96h	76-100 mg/L		4
Perch	LC$_{50}$ 96h	16.0 mg/L		5
Guppy	LC$_{50}$ 96h	4.3 mg/L		4
Pink shrimp	LC$_{50}$ 96h	6.9 mg/L		5
Daphnia	*EC$_{50}$ 48h*	*5.2-8.1 mg/L*		*5*

[i] TOXICITY (OTHER) — No observable ill effects in cattle, dogs, horses or rats fed >25.0 mg/kg in diet over extended periods. Two year rat feeding study showed no gross or microscopic signs of toxicity at levels as high as 100 mg/kg. At 25.0 mg/L, atrazine appears to have no significant effects on the structure of macroinvertebrate populations, periphyton standing biomass, or rates of primary production and community respiration.[8] Not toxic to bees.

[ii] PHYTOTOXICITY — Sensitive crops include most vegetables, cereals, asparagus, soybeans, peanuts, potatoes. Inhibits photosynthesis in phytoplankton, but may eventually result in the successional establishment of species of phytoplankton more resistant to inhibition by atrazine.[7]

7. METABOLISM

[i] ANIMAL - In one study, a 0.53 mg dose of atrazine was administered to rats: 15% was retained in the liver, kidney, and lungs.[6] The major metabolites are 2-hydroxyatrazine and its two mono-N-dealkylated metabolites. In mammals, more than 50% of the dose is eliminated in the urine and 33% in the faeces within 24 hours. [1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Moisture activates the chemical. Solubility in water is 28 mg/L @ 20°C.[6]

9. REFERENCES

1. PM
2. HH
3. PMRA
4. HSDB
5. CESARS
6. PP
7. DeNoyelles, F., W.D. Kettle and D.E. Sinn (1982) The responses of plankton communities in experimental ponds to atrazine, the most heavily used pesticide in the United States. *Ecology*, 63: 1285-1293.
8. Lynch, T.R., H.E. Johnson and W.J. Adams (1985) Impact of atrazine and hexachlorobiphenyl on the structure and function of model stream ecosystems. *Environ. Toxicol. Chem.* 4: 399-413.
9. Tyrone B. Hayes, Atif Collins, Melissa Lee, Magdelena Mendoza, Nigel Noriega, A. Ali Stuart, and Aaron Vonk (2002). Hermaphroditic, demasculinized frogs after exposure to the herbicide atrazine at low ecologically relevant doses. *Proc. Natl. Acad. Sci.* USA. 99 (8):5476-5480.

Azinphos-methyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — azinphos-methyl (BSI, E-ISO, F-ISO); azinphosmethyl (ESA); metiltriazotion (exception former USSR)

[ii] TRADE NAME — Guthion (Bayer CropScience); APM (Norac Concepts Inc.); Sniper (United Agri Products)

[iii] CHEMICAL NAME — *S*-(3,4-dihydro-4-oxobenzo[*d*]-[1,2,3]-triazin-3-ylmethyl) *O,O*-dimethyl phosphorodithioate

[iv] CAS # — 86-50-0

[v] TYPE / MODE OF ACTION— An organophosphorus insecticide and acaricide. Stomach and contact poison. Cholinesterase inhibitor.

[vi] NOTICE — In Canada, **all uses of azinphos-methyl are to be phased out** as risks to both workers and the environment have been identified. **Uses of azinphos-methyl products for which alternatives exist will be phased out by the end of 2003, other uses are to be phased out by the end of 2005.** Currently, the use pattern of azinphos-methyl has also been restricted by the Prince Edward Island Government, requiring a permit for use on fields adjacent to streams, following inspection. **Bayer CropScience has voluntarily ceased sales of the product Guthion in Prince Edward Island.** The U.S. EPA has planned a phase-out/cancellation of azinphos-methyl use on potatoes and various other crops by the end of 2005. Cancellation of use issued to improve worker safety and lessen ecological risks.

2. USE PATTERN

Azinphos-methyl is a non-systemic insecticide and acaricide of long persistence, chiefly effective against chewing and sucking insects. Foliar applications may be made on a wide variety of fruit, vegetable, nut, melon and field crops [including tobacco] as well as ornamentals, forest and shade trees, to control many insect pests.

[i] APPLICATION — Apply at uniform rate in power operated ground and aircraft sprayers. Repeat as necessary. Mixed with water to form a suspension. Aerial applications with a minimum of 40 L water/ha.[3]

[ii] RATES — Field crops, 0.28-0.88 kg a.i./ha in 80-200 L water. Apple, pear, 0.25-0.38 kg a.i./ha in 1000 L water. Ornamentals, 0.5-5.0 kg a.i./ha.[3]

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. EC
3. DU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 35-42 m
2. Air blast application: Calculated: 34(43)-36(45) m
3. Aerial application: Calculated: >1000 m
4. Forestry application: Calculated: 580->1000 m

3. STORAGE

Decomposes at elevated temperatures with gas evolution. Subject to hydrolysis. Store in original container, preferably in locked storage area away from food, feed and children.[7] Store in 2L formulation above 45°F.[4]

4. HANDLING PRECAUTIONS

Always wear protective clothing, natural rubber gloves, goggles and respirator. Wash thoroughly before eating or smoking. Do not feed treated crop residue to livestock. Wear protective clothing when entering treated areas within 2 days of application.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Variable persistence in soil. Half-life in a sandy loam soil is 5 days.[5] Residual effects last 1-3 weeks. Adsorbs strongly to soil particles and has low leaching potential. Degradation involves oxidation, demethylation, and hydrolysis.[1]

[ii] AQUATIC — Rapid biodegradation in natural waters. Half-life ~2 days.[5] Chemical hydrolysis important in natural waters.[4]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	4.4-16.0 mg/kg		5
Rat	LD_{50} dermal	220 mg/kg		5
Guinea pig	LD_{50} oral	80.0 mg/kg	Male	1
Dog	LD_{50} oral	>10.0 mg/kg		1
Dog	NOEL 1y	5.0 mg/kg/diet		1
Human	ADI	0.005 mg/kg b.w.		1
Chicken	LD_{50} oral	262 mg/kg		5
Mallard	LD_{50} oral	136 mg/kg b.w.		5
Bobwhite quail	LD_{50} oral	32.0 mg/kg		1
Pheasant	LD_{50} oral	74.9 mg/kg		5
Chukar	LD_{50} oral	84.2 mg/kg		5
Rainbow trout	LC_{50} 96 h	20.0 µg/L		1
Guppies	LC_{50} 96 h	0.1 mg/L		2
Goldfish	LC_{50} 96 h	>1.0 mg/L		2
Fathead minnow	LC_{50} 96 h	0.093 mg/L		2
Largemouth bass	LC_{50} 96 h	0.052 mg/L		2
Brown trout	LC_{50} 96 h	4.0 µg/L		2
Coho salmon	LC_{50} 96 h	0.017 mg/L		2
Perch	LC_{50} 96 h	0.013 mg/L		2
Channel catfish	LC_{50} 96 h	3.29 mg/L		2
Black bullhead	LC_{50} 96 h	3.5 mg/L		2
Daphnia	*EC_{50} 48h*	*0.0011 mg/L*		*1*

[i] TOXICITY (OTHER) — Low to high toxicity.[6] Highly toxic to bees. Highly toxic to fish and wildlife. Toxic to snails and slugs.[5] Absorbed through skin.[2] Poison can cause sense of "tightness" in chest, sweating, contracted pupils, stomach pains, vomiting and diarrhea. Carcinogenic status unclear. Irritating to eyes and skin. May cause russeting on certain varieties of fruit.[5]

[ii] PHYTOTOXICITY – Russeting is possible on some fruit varieties with the emulsifiable concentrate formula.[1]

7. METABOLISM

[i] ANIMAL - In mammals, >95% is excreted within 2 days following oral administration.[1] Readily absorbed from gut. Benzazamide is a major metabolite. Benzotriazin moiety is rapidly excreted in man and animals; concentration in particular organs does not occur.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Incompatible with Bordeaux mixture, lime sulphur and lime. Compatible with other pesticides. Do not use on greenhouse crops.

9. REFERENCES

1. PM
2. AC
3. PMRA
4. HSDB
5. PP
6. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO Meeting on pesticide residues. II, Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews*, 63: 1-44.
7. FCH

Bacillus thuringiensis (Bt)

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME —Bacillus thuringiensis *Bacillus thuringiensis*. Various subspecies or strains exist. Common forms include Bt *israelensis* (Serotype H-14) and Bt *kurstaki*.

[ii] TRADE NAME — Vectobac 200G, Foray 48B, Dipel (Abbott Laboraties); Thuricide HPC (Thermo Trilogy Corporation); Teknar, Aquabac. *Foray 76 b (Abbott Laboraties); Novabac 3 (Cyanamid Crop Protection).*

[iii] CHEMICAL NAME – Not identified.

[iv] CAS # - Not identified.

[v] TYPE / MODE OF ACTION — Biological control product insecticide. The bacterium Bt produces spores and crystalline endotoxins which, when eaten, dissolve in the intestine of susceptible insect larvae. Crystals paralyse cells in the gut and interfere with normal digestion.[1]

2. USE PATTERN

[i] APPLICATION — Bt *israelensis*: Applied to aquatic streams for the control of aquatic dipteran larvae (*i.e.*, blackflies). Applied to temporary pools in pastures and woodlots, irrigation or roadside ditches, natural marshes or estuarine areas, catch basins and sewage lagoons for the control of mosquitos.

Bt *kurstaki*: Low volume aqueous concentrate for forests, woodlands, trees, and shrubs. Direct target for application is the foliage, buds, and flowers. Undiluted aerial applications are recommended for control of lepitopteran insects such as spruce budworm, forest tent caterpillar, and gypsy moth.[2]

[ii] RATES — Bt *israelensis*: 0.5-2.0 L/ha. Bt *kurstaki*: 0.55-1.1 kg/ha for vegetables, 1.5-9.5 L/ha for aerial applications depending on the pest. Active ingredient is often given in terms of International Potency Units/mg. Refer to product label.

CARRIER: Not identified.

[iii] FORMULATIONS

1. WP
2. SU
3. GR
4. PT
5. SN

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 0-8 m
2.	Air blast application:	Calculated: 2(3)-8(16) m
3.	Aerial application:	Calculated: 0->45 m
4.	Forestry application:	Not identified.

3. STORAGE

Store at temperatures between 0 to 30°C, cooler storage temperatures are preferred. Store containers upright and keep tightly closed when not in use. Loss of potency may occur in Bt *israelensis* if product is stored for more than 6 months. Bt *kurstaki* formulations are stable for 1-3 years if maintained in a cool, dry place.[1] Not compatible with broad spectrum fungicides such as copper compounds.[1]

4. HANDLING PRECAUTIONS

Avoid inhalation or contact with eyes or skin. Avoid direct application to ponds, lakes, and streams. Render empty container unsuitable for any additional use.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Will persist in soil for several months. The half-life in suitable conditions for Bt ia 4 months.[6] There appears to be a maximum carrying capacity in most soils for bacterial populations. Fate in soil depends on microbial competition. Not well adapted to soil environments and will not grow (*i.e.*, vegetatively) under most natural soil conditions.

[ii] AQUATIC – Bt *israelensis*: Able to persist naturally in field populations. Can be effective for up to 48 hours in water. [6] Under warm water conditions and microbial load, degradation occurs rapidly. Requires specific nutrients to be present at certain levels.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Bt *kurstaki*: Loses 50% of its insecticidal activity in 1-3 days, although some viable endospores have been recovered from foliage one year after ground application. It may persist as viable spores in lake waters for considerable lengths of time (> 70 days); however, in streams and rivers it is far less persistent. Exposure to sunlight, leaf temperature and vapour pressure deficit contribute to endospore decay on foliage.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} dermal	>5000 mg/kg	Thuricide (Bt *kurstaki*)	1
Mummichug	LC_{50} 96h	980 mg/L	Bt *israelensis*	4
Rainbow trout	LC_{50} 96h	>0.656mg/L		5
Salvenius fontinalis	LC_{50}	4500-6000 mg/L	Bt *israelensis*, 86% mortality	3
Water gobie	LC_{50} 96h	>400 mg/L	Thuricide (Bt *kurstaki*)	1
Toecilia retriculata	*LC_{50} 96h*	*>156 mg/L*	*Teknar (Bt* israelensis*)*	*1*

[i] TOXICITY (OTHER) — Chironomids, or non-biting midge larvae are severely impacted as a result of Bt *israelensis* stream applications. Their importance in the food chain has not been clearly documented. Not toxic to bees.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not poisonous to plants and has not shown any adverse effect upon seed generation or plant vigor. [6]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. PMRA
3. Molloy, D.P., "Progress in the biological control of black flies with Bti, with emphasis on temperate climates", in press. In: H.de Barjac and D.J. Sutherland (eds), Bacterial Control of Mosquitoes and Black Flies, Rutgers University Press, New Brunswick, NJ, 1989.
4. Byung Mu Lee & G.I.Scott, "Acute Toxicity of Temephos, Fenoxycarb, Diflubenzuron, and Methoprene and Bacillus thuringiensis var. israelensis to the Mummichog (Fundulus heteroclitus)", Bull. Environ. Contam. Toxicol., 43: 827-832, 1989.
5. ECOTOX
6. PP

Bendiocarb

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — bendiocarb (BSI, E-ISO, ANSI, ESA); bendiocarbe (F-ISO)

[ii] TRADE NAME — Ficam W, Ficam Plus (Agr Evo USA Co.); Trumpet (Plant Products Co. Ltd.); Turcam.

[iii] CHEMICAL NAME — 2,2-dimethyl-1,3-benzodioxol-4-yl methylcarbamate

[iv] CAS # — 22781-23-3

[v] TYPE / MODE OF ACTION— Residual carbamate insecticide and acaricide. Inhibits cholinesterase; effective as a contact and stomach poison with some systemic activity in crop plants.[1]

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

For the control of cockroaches and crickets, carpet beetles, earwigs, ants, silverfish, wasps, fleas, brown dog ticks, bedbugs, etc. in non-crop, non-fabric and non-food commodities and ornamentals in vehicles, foodstores, houses and other buildings by professional applicators. Granular formulations are used against turf pests. Some experimental use on crops (*e.g.*, rice, cotton, small grains, potatoes). This product gives rapid knockdown and good residual activity.[3]

[i] APPLICATION — Apply when insects appear, repeat as necessary.[3] Use only as a space spray for application to surfaces. May be used as a seed treatment.

[ii] RATES — Apply to the soil at 0.83-1.1 kg a.i./ha.[3] One packet Ficam Plus in 4 L water yields a conventional spray volume of 6.25% bendiocarb.

CARRIER: Water.

[iii] FORMULATIONS

1. SO
2. WP
3. DU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

When added to water, spray solution changes from white to brown after a few days; discard when this happens. Do not store near foodstuffs.

4. HANDLING PRECAUTIONS

Avoid contact with eyes, skin, clothing. Wear rubber or PVC gloves and face shield when handling concentrate; wash concentrate from skin and eyes immediately. Avoid all contact by mouth. Avoid working in spray mist. Wash hands and exposed skin before eating, drinking or smoking. Remove or cover all food during applications; protect food preparing equipment, surfaces, and utensils from contamination during application. Remove animals during application. Do not use on any food or feed crops. Incompatible with alkaline materials.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – The half-life varies with soil type from less than a week to up to 4 weeks, it also has a low soil persistence. [4]

[ii] AQUATIC – Bendiocarb is stable to hydrolysis in water at pH5. At pH7 and 25°C, 50% decomposition occurs in 4 days. The metabolites produced include: (1) 2,3-isopropylidenedioxyphenol, (2) methylamine and (3) carbon dioxide. Bendiocard can move to surface water through run-off but is not expected to absorb to suspended solids or sediment.[5]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50}	40.0-156 mg/kg		2
Rat	LD_{50} dermal	566-800 mg/kg		1
Rat	NOEL 2y	10.0 mg/kg diet		1
Rabbit	LD_{50} oral	35.0-40.0 mg/kg		1
Human	ADI	0.004 mg/kg b.w.		1
Mallard	LD_{50} oral	3.1 mg/kg		4
Bobwhite quail	LD_{50} oral	19.0 mg/kg		1
Bluegill sunfish	LC_{50} 96h	1.65 mg/L		1
Rainbow trout	LC_{50} 96h	1.55 mg/L		4
Daphnia	*EC_{50} 48h*	*0.16 mg/L*		*1*

[i] TOXICITY (OTHER) — Harmful or fatal if swallowed. May be absorbed through skin. Moderately toxic to birds.[4] Not likely to accumulate in fish due to its moderate water solubility, and rapid degradation in water. Acute risks to mammals when used at the maximum registered rate.[5] Toxic to honey bees (LD_{50} 0.1 µg/bee).[4] Mild irritant to eyes and skin.[4]

[ii] PHYTOTOXICITY – Non-phytotoxic when used as directed. Not to be used on coleus.[1]

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Ten weeks control can be expected. Has no smell, does not stain treated surface.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PP
5. USEPA. 1999. R.E.D. Facts: Bendiocarb. Prevention, Pesticides and Toxic Substances. EPA-738-F-99-010, September.

Benomyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — benomyl (BSI, E-ISO, F-ISO, ANSI, JMAF)

[ii] TRADE NAME — Benlate (Dupont Canada Inc.); Later's Benomyl (Later Chemical)

[iii] CHEMICAL NAME — methyl 1-(butylcarbamoyl) benzimidazol-2-ylcarbamate

[iv] CAS # — 17804-35-2

[v] TYPE / MODE OF ACTION — A carbamate compound used as a systemic foliar fungicide.

[vi] NOTICE — **All uses of benomyl are being discontinued in Canada**. As of December 31, 2003 commercial class products will no longer be available for sale. Domestic class products registrations last date of sale is December 31, 2005. Benomyl is no longer registered for use in the U.S. The U.S. EPA cancellation order was effective January 15, 2002.

2. USE PATTERN

Effective against a wide range of fungi on fruit, nuts, vegetables, field crops, turf and ornamentals. Also effective as a mite ovicide.[5] An illegal use pattern for earthworm control at airports had occured since the early 1970's. An agreement to allow this use pattern has not been reached (January 1999).

[i] APPLICATION — Can be used as a dip on sugarcane and pineapple seed pieces. Also used as a pre- or post-harvest spray or dip for control of storage rots in fruits and vegetables. Inject into elm trunks for control of Dutch Elm disease. FOLIAR SPRAY (ground or aerial): Apply when disease first appears and repeat at 10-21 day intervals.

[ii] RATES — 12.5-140 g a.i./L water as a foliar spray. Use 140-1550 g a.i./ha for field and vegetable crops and 550-1100 kg/ha on tree crops. 25.0-200 g/100 L for post-harvest use.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. GR

[vi] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 9-13 m
2. Air blast application: Calculated: 3(5) m
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

This compound is non-volatile at room temperature and non-corrosive to metals. Decomposes in aqueous solution catalyzed by acid. Keep dry during storage.

4. HANDLING PRECAUTIONS

Incompatible with alkaline pesticides.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Benomyl and its metabolites (MBC, 2-AC) are immobile in soil; does not leach or move significantly from the application site.[7] Easily hydrolyzed to relatively stable methyl-2-benzimidazole (MBC), which is considered to be the main fungitoxic metabolite.[5] Excellent residual activity.

[ii] AQUATIC – Surface water half-life of 2 hours.[9]

[iii] ATMOSPHERIC – Estimated half-life of 1.6 hours, based on the vaopur-phase reaction with hydroxyl radicals in air.[9]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>10,000 mg/kg		2
Rat	NOEL 2y	>2500 mg/kg diet	No evidence of toxicity	1
Rabbit	LD_{50}	>3400 mg/kg	50% WP formulation	4
Mallard and quail	LD_{50} dietary	>500 mg/kg diet		1
Redwing blackbird	LD_{50}	100 mg/kg		4
Rainbow trout	LC_{50} 96h	0.17 mg/L		1
Guppy	LC_{50} 48h	3.4 mg/L		1
Crayfish	LC_{50}	>100 mg/L		4
Daphnia	*EC_{50} 48h*	*0.64 mg/L*		*1*

[i] TOXICITY (OTHER) — Highly toxic to fish.[3] Long-term doses of 62.5 mg/kg/day to Wistar rats by gavage showed fetotoxic and teratogenic effects.[8] A dominant lethal study in rats (up to 2800 µg/kg in diet) was negative.[5] Relatively non-toxic to bees. Very toxic to earthworms (LC_{50} 14d, 0.4 mg/L).[4] Skin irritant.[4]

[ii] PHYTOTOXICITY — Non-phytotoxic when used as directed. Apples do not express the fine fruit finish noted with other fungicides. Russeting is possible with with Golden Delicious apples.[1]

7. METABOLISM

[i] ANIMAL – Hydroxylated methyl benzimidazole carbamates formed, with MBC as a probable intermediary. MBC and possibly 2-AB are likely to be primary compounds absorbed from gut after ingestion of benomyl residues.[6] Rapidly absorbed, metabolized primarily in the liver, and excreted. Metabolism mainly by hydrolysis and hydroxylation. Metabolites are excreted in urine and faeces; do not appear to be stored in body tissues. Cow's milk and eggs only contain detectable residues at high rates of application.[7]

[ii] PLANT – Half-life on foliage was 3-7 days.[9]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PP
5. Nakashima, M.J. & B.A. Crofts (1974) Toxicity of benomyl to the life stages of *Amblyseius fallacis*. *J. Econ. Entomol.* 67: 675-677.
6. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO meeting on pesticide residues. II. Carbamate and organophosphorous pesticides used in agriculture and public health. *Residue Reviews*, 63: 1-44.
7. WHO, Geneva (1976) 1975 Evaluations of some pesticide residues in food. *WHO Pesticide Residues Series*, No. 5: 409 pp.
8. Kavlock, R.J., N. Chernoff, L. Earl Gray, Jr., J.A. Gray and D. Whitehouse (1982) Teratogenic effects of benomyl in the Westar rat and CD-1 Mouse with emphasis on the route of administration. *Toxicol. and Applied Pharmacol.* 62: 44-54.
9. IH

Bensulide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — bensulide(BSI, E-ISO, F-ISO, WSSA); SAP (JMAF)

[ii] TRADE NAME — Proturf (Nu-Gro IP Inc.); *Prefar, Betasan (Gowan Co.)*

[iii] CHEMICAL NAME — *S*-2-benzenesulphonamidoethyl *O,O*-di-isopropyl phosphorodithioate

[iv] CAS # — 741-58-2

[v] TYPE / MODE OF ACTION— A sulfonamide compound used as a pre-emergence selective herbicide.

2. USE PATTERN

Used on cotton, broccoli, Brussel sprouts, cabbage, carrots, grasses grown for seed, cauliflower, melons, onions, lettuce, cucumbers, squash, ornamentals, turf, peppers, tomatoes and dichondra. Used on rice in Japan.

[i] APPLICATION — Should be used prior to germination of weed seeds. It should be applied to established grass lawns, prior to planting, or on established dichondra lawns. The compound must be watered into the soil after application. It provides a long residual control of the weeds for which it is registered. Care should be taken if reseeding with grass is planned following treatment.

[ii] RATES — 2.3-5.0 kg. Applied at active/ha for pre-plant use on brassicas, cucurbits, and lettuce. Higher rates of 2.11-22.0 kg a.i./ha are used on established turf, 156 g a.i./100m^2, 4.6-9.1 g a.i./ha.

CARRIER: Water at the rate of 25 to 50 L per 100-120 m^2 is the usual carrier for emulsifiable liquid formulations of Betasan. Prefar is applied in 187 to 468 L of water per ha.

[iii] FORMULATIONS

1. EC
2. GR

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 4-42 m (As per PMRA re-evaluation document 04/03)
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Apparently indefinite storage life under normal ambient conditions. Photosensitivity is indeterminate. Corrosive to copper, non-corrosive to other metals. Store in original container.

4. HANDLING PRECAUTIONS

Apply to lawns only when they are well established. Temporary yellowing may occur to Bermuda turf. Do not reseed turf sooner than 4 months after treatment. Bensulide is a long residual herbicide so injury to crops may occur following a treated crop. Do not plant crops other than those on the label for a period of 18 months. Use on mineral soil only. No known incompatibilities with hard water or other pesticides. Relatively stable to acids and alkalis.[1]

5. ENVIRONMENTAL PERSISTENCE

Will remain active in soil over winter.[6] The effects of bensulide persist for 0.33-1.0 years, according to the rate of application.

[i] SOIL — Inactivated in soils containing high organic matter. Leaches very little in sand, clay or organic soils [4]. Half-life in moist loam at 21-27°C is 4 months; in moist loamy sand at 21-27°C it is 6 months. Slowly degraded by soil micro-organisms.[4] Very little volatilization from soil, but small amount of photodecomposition over several days.[4]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION — Unchanged ring-labelled Prefar-^{14}C detected in roots of lettuce but not leaves after root application. Large part of labelled material in leaves evolved as CO_2; some present as labelled amino acids.[4]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	270 mg/kg	Female rats	1
Rat	LD_{50} oral	360 mg/kg	Male rats	1
Rat	NOEL 90d	25.0 mg/kg/d		1
Rat	LD_{50} dermal	>2000 mg/kg		1
Rabbit	LD_{50} dermal	3950 mg/kg	Tech. Betasan	3
Dog	NOEL 90d	2.5 mg/kg/d		1
Bobwhite quail	LD_{50} oral	1386 mg/kg/		5
Rainbow trout	LC_{50} 96h	1.1 mg/L	Tech. Betasan	1
Bluegill	LC_{50}	1.4 mg/L		5
Goldfish	LC_{50} 96h	1.0-2.0 µl/L		3
Brown shrimp	EC_{50} 96h	>1.0 µl/L	Tech. Betasan	3
Daphnia	*EC_{50} 48h*	*0.58 ppm*		*1*

[i] TOXICITY (OTHER) — Exposure to bensulide may cause ChE inhibition.[2] Not carcinogenic or teratogenic.[1]

Slightly toxic to birds, moderately to highly toxic to aquatic organisms, moderately toxic to aquatic invertebrates, and very highly toxic to bees.[5]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - When applied to the roots bensulide is not translocated to the leaves but its metabolites are.[1]

8. ADDITIONAL INFORMATION

All established turf grasses tested have been tolerant. Dichondra is very tolerant to pre-plant, pre-emergence and post-emergence applications. A large number of ground covers and ornamentals have been treated and found to be tolerant. Must be applied before the weeds emerge. Six to eight months control may be expected. Fairly resistant to leaching.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. PP
6. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control.* Atlantic Supplement Edition. 101 pp.

Bentazon

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — bentazone (BSI, E-ISO, F-ISO, JMAF); bentazon (ANSI, Canada, WSSA); bendioxide (Republic of South Africa)

[ii] TRADE NAME — Basagran, Laddok (BASF Canada Inc.)

[iii] CHEMICAL NAME — 3-isopropyl-1*H*-2,1,3-benzothiadiazin-4 (3*H*)-one 2,2-dioxide.

[iv] CAS # — 25057-89-0

[v] TYPE / MODE OF ACTION— A benzothiadiazole compound used as a selective post-emergence herbicide.[2] Mainly a contact herbicide, bentazon is either absorbed by the foliage, or absorbed by the roots and moved acropetally through the xylem tissue. The chemical causes an inhibition of the Hill reaction and photosynthesis.[4]

2. USE PATTERN

For selective post-emergence broadleaf weed control in soybean, dry and snap beans, peas, sweet and seed corn, newly planted fruit trees, and turf. Controls such weeds as velvetleaf, nutsedge, Canada thistle, morning glory, ragweed, mustard, mayweeds, cocklebur, and many others. Bentazon will not control seedling forage legumes and seedling forage grasses.

[i] APPLICATION — May be applied by ground or air. Must be applied post-emergence, preferably when weeds are growing rapidly and are at the 2 to 10 leaf stage. Nutgrass is more effectively controlled with a split application. Addition of a wetting agent may increase the activity of this material. Do not apply if rain is expected within 10 hours of application. Results will be apparent in 2-7 days after application.

[ii] RATE — GENERAL: 0.84-2.24 kg a.i. in 47-374 L water/ha.[4] CEREALS: 1.1-2.2 kg a.i. in 100-450 L water/ha.

CARRIER: Water.

[iii] FORMULATIONS

1. SU
2. SN (DU not registered in Canada)

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Not identified.
3. Aerial application:	Calculated: 0 m
4. Forestry application:	Not identified.

3. STORAGE

Non-flammable, non-corrosive. Unchanged after 3 months at 50°C. Store in a clean dry place. Do not allow this material to freeze.[4]

4. HANDLING PRECAUTIONS

Avoid contact with eyes or skin. Avoid contamination of water, food, or feed by storage or disposal. Very resistant to hydrolysis in both acidic and alkaline media. Decomposed by sunlight.[1]

5. ENVIRONMENTAL PERSISTENCE

Bentazon is stable to hydrolysis,[3] and is not subject to volatilization.

[i] SOIL — The persistence of bentazon varies with soil-type but reaches undetectable levels within 6 weeks. It is photodegraded in aerobic soil, with a half-life of <1 month.[3] Bentazon levels are calculated to remain greater than 0.2 kg/ha for 3-12 days after an application of 1.0 kg/ha.[6] It is mobile in soil but rapid degradation is expected to prevent groundwater contamination.[7] Leaching capacity of its metabolites is unknown. Bentazon may contaminate surface water due to its mobility in runoff water.[3] Bentazone is subject to breakdown by ultraviolet light from the sun.[5] It is rapidly utilized by soil bacteria and fungi.[4]

[ii] AQUATIC — Photodegradable in water, with a half-life of less than 24 hours as it is readily broken down by sunlight.[3]

[iii] ATMOSPHERIC – Bentazone is expected to exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase bentazon is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals (SRC); the half-life for this reaction in air is estimated to be 6.2 hours.[8]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comment*	*Ref.*
Rat	LD_{50} oral	1100-2063 mg/kg		5
Mouse	LD_{50} oral	400 mg/kg		4
Rabbit	LD_{50} oral	750 mg/kg		1
Rabbit	LD_{50} dermal	4000 mg/kg		5
Cat	LD_{50} oral	500 mg/kg		4
Dog	NOEL 1y	13.1 mg/kg		1
Human	ADI	0.1 mg/kg		1
Bobwhite quail	LD_{50} oral	1140 mg/kg		1
Mallard	LD_{50} oral	2000 mg/kg		5
Bluegill	LC_{50} 96h	616 mg/L	Technical grade	5
Rainbow trout	LC_{50} 96h	190 mg/L		4
Daphnia	*EC_{50} 48h*	*125 mg/L*		*1*

[i] TOXICITY (OTHER) — Harmless to bees. Skin and eye irritation is moderate. No adverse pathological or toxicological effects in rats exposed to 200 mg/L of BAS 3512 dust for 1 h daily over a period of 14 days.[4] Bentazon is unlikely to pose an acute hazard to most non-target organisms because of its generally low toxicity, based on available data, and low application rates.[3] Practically non- toxic to coldwater and warmwater fish, slightly toxic to aquatic invertebrates.[5]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL — Residues consist of the metabolite AIBA and bentazon. It is poorly metabolized. Rats administered with labled bentazon were found to excrete 91% in the urine and 0.9% in the faeces as the parent compound.[7] It bioaccumulates in the tail meat and viscera of crayfish.[3]

[ii] PLANT — Rapidly metabolized in tolerant species, forming extractable conjugates which are then incorporated into plant components.[4]

8. ADDITIONAL INFORMATION

No pre-emergence activity has been noted. May be combined with phenoxy compounds.

9. REFERENCES

1. PM
2. AC
3. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
4. HH
5. PP
6. Gaynor, J.D. and A.S. Hamill (1983) Bentazon pre-emergence activity on Velvetleaf (*Abutilon theophrasti medic*) and persistence in southern Ontario soils. *Can. J. Plant. Sci.* 63: 1015-1022.
7. (U.S.) Environmental Protection Agency Washington, DC Aug. 88. Health Advisories for 50 Pesticides (Including Acifluorfen, Ametryn, Ammonium Sulfamate Atrazine, Baygon, Bentazon, Bromacil, Butylate, Carbaryl, Carboxin, Chloramben, Chlorothalonil Cyanazine, Dalapon, Dacthal, Diazinon, Dicamba L, 3-Dichloropropene, Dieldrin, Dimethrin, Dinoseb Diphenamid, Disulfoton, Diuron, Endothall Ethylene Thiourea, Fenamiphos, Fluometuron Fonofos, Glyphosate, Hexazinone, Maleic Hydrazide MCPA, Methomyl, Methyl Parathion, Metolachlor, Metribuzin, Paraquat, Picloram, Prometon Pronamid, Propachlor, Propazine, Propham, Simazine, 2,4,5-T, Tebuthiuron, Terbacil Terbufos and Trifluralin) PB88-245931.
8. RRIP

Borax

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The trivial name borax (E-ISO, F-ISO) is accepted in lieu of a common name. The trivial name sodium octaborate and sodium metaborate are also used.

[ii] TRADE NAME — Wilson Liquid Antex (Nu-Gro IP Inc.); Later's (Later Chemicals Inc.); *Greenleaf Hybor-D (Greenleaf Products Inc.).* Other names include Pematox, Chapco SSC Concentrate, Triox, and Ecobrite.

[iii] CHEMICAL NAME — disodium tetraborate decahydrate

[iv] CAS # — 1303-96-4

[v] TYPE / MODE OF ACTION — Non-selective herbicide $(BNaO_2)x$, material preservative, and insecticide. An inorganic boron salt used for total vegetation control.[2]

2. USE PATTERN

In a mixture with sodium chlorate, as a non-selective herbicide on uncropped land and for spot treatment of Johnson grass. Used in insect baits for food stores to control ants and in dog kennels to aid in control of dog hookworm larvae.[2] Also used to control maggots in manure in poultry houses, as a sapstain and mould preventative for lumber, and in dwellings and outdoor living areas.

[i] APPLICATION — Dry or spray overall; pre- or post-emergence. May be applied by hand or mechanical spreaders.[3] Can be added to water and aqueous solutions, and applied to both plants and soil.

[ii] RATES — 244-1950 g/10 m^2. Lighter rates for annuals; heavier for deep-rooted perennials and prepaving treatment.

CARRIER: Water, 200 g/L; 1123-8986 L/ha.

[iii] FORMULATIONS

1. SN
2. GR
3. SG
4. SP, including mixtures with sodium chlorate and with organic herbicides such as bromacil.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable. Non-flammable, non-corrosive to ferrous metal, rubber and plastics. Non-volatile. Can be stored with little or no risk to fungicides, insecticides and fertilizers.[4] Incompatible with some herbicides as its aqueous solution is alkaline.[1] Preserve in tightly lidded containers.[5]

4. HANDLING PRECAUTIONS

Wear goggles or face shield, long-sleeved shirt, long pants, shoes, socks and chemical-resistant gloves when handling.[5] Keep out of reach of children, wash hands and clothing after handling this substance. Do not wear contact lenses while handling Borax.[5]

5. ENVIRONMENTAL PERSISTENCE

Borax is slow acting. Not deactivated by light.[4]

[i] SOIL — One growing season in areas of 85 cm of precipitation or greater. Rapid leaching in high rainfall areas.[3] Some adsorption on clay. No microbial breakdown.[3] Disappearance from soil is by washing out.[1] It persists for ≤ 2 years, but the duration of the protection given is markedly dependent on rainfall and soil structure. Borax persists for longer periods in heavy clay and/or alkaline soils.[2]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	4500-6000 mg/kg		1
Rabbit	LD_{50} dermal	>10000 mg/kg		1
Dog	NOEL 2y	78.0 mg/kg/d		1
Rainbow trout	LC_{50} 24d	1320 mg/L	Disodium tetraborate decahydrate	1
Daphnia	*EC_{50} 48h*	*1170 mg/L*	*Disodium tetraborate decahydrate*	*1*

[i] TOXICITY (OTHER) — Moderate skin irritant. Low toxicity to wildlife, birds, fish and aquatic invertebrates.[5] Not hazardous to bees.[1] Toxic to most soil microorganisms.[4]

[ii] PHYTOTOXICITY - Very phytotoxic. This chemical is an essential plant nutrient in very minute amounts. Not to be used near desired plants.[1]

7. METABOLISM

[i] ANIMAL – Not metabolized in animals.[1]

[ii] PLANT - Accumulates in plants. Uptake is through the roots. It is then translocated throughout the entire plant, but especially to the leaves. Plant desiccation begins with burning and necrosis of the leaf margins.[4]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. AC
3. HH
4. Klingman, G.C. and F.M. Ashton. Weed Science: Principles and Practices. John Wiley and Sons, New York, 1975. 431 pp.
5. RRIP

Boric acid

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — Boric acid (or boracic acid)

[ii] TRADE NAME — Blue Diamond Magnetic Roach Food (Blue Diamond Ext. Co. Inc.); Borid (Waterbury Co. Inc.); *Mr. Roachkiller Paste Formula 3000 (Mr. Roachkiller Inc.); Boraton (Sanex Agro Ltd.).*

[iii] CHEMICAL NAME — Boric acid (or boracic acid)

[iv] CAS # — 10043-35-3

[v] TYPE / MODE OF ACTION — Insecticide with stomach action.

2. USE PATTERN

For the elimination of cockroaches.

[i] APPLICATION — For Blue Diamond paste, use a small putty knife to apply liberally in heavily infested areas and sparingly in lightly infested areas in homes and other places. Apply the paste into seams under and behind refrigerators, stoves, dishwashers, washing machines, dryers, tubs; into openings and drains, sewers, manholes, water pipes, and electrical conduits; in cracks and crevices along baseboards and in corners of cabinets, cupboards and food closets. Remove all lower drawers in kitchen and bathroom cabinets, bedroom dressers and chests of drawers, then apply the paste into each corner of the drawer wells.[1]

[ii] RATES — For Blue Diamond paste, use 560 g in an area of approximately 200 m^2, applying paste liberally in heavily infested areas and sparingly in lightly infested areas.

CARRIER: Not identified.

[iii] FORMULATIONS

1. PA
2. PP
3. DU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Keep out of reach of children and pets. Do not contaminate food or feed with storage. Store in original containers in a cool dry place. Do not store at extreme temperatures.

4. HANDLING PRECAUTIONS

Do not place bait stations in areas accessible to children or pets. May be harmful if swallowed. Do not remove bait from stations. Avoid contamination of food or feed by storage or disposal. Do not place bait directly over food, utensils, dishes or food preparation surfaces. Do not contaminate water through improper disposal. Discard used containers in garbage. Never place bait stations in broad, open areas. May cause eye irritation. Avoid contact with eyes and injured or broken skin. Wash thoroughly after handling.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – The average persistance at the recommended application rate is one or more years depending on soil type and rainfall.

[ii] AQUATIC – Boric acid is soluble in water, adsorbs to the mineral portion of soil and is slowly leached. No microbial breakdown.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Loss by photodegradation/volatilization has been observed.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50}	900 mg Boron/kg		2
Mouse	LD_{50}	466 mg Boron/kg		2
Rainbow trout	LC_{50} 48h	339 mg/L		3
Coho salmon	LC_{50} 283h	113 mg/L		3
Mosquito fish	LC_{50} 96h	980 mg/L		3
Daphnia	LC_{50} 48h	226 mg/L	Static bioassay	2
Daphnia	*LC_{50} 48h*	*133.0 mg/L*		*4*

[i] TOXICITY (OTHER) – Not identified.

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PMRA
2. HSDB
3. HH
4. Verschueren, Karel. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Co., 1983.

Brodifacoum

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — brodifacoum (BSI, E-ISO, F-ISO)

[ii] TRADE NAME — Ratak + Rodenticide,Talon (Zeneca Agro); *Wilsarin*.

[iii] CHEMICAL NAME — 3-[3-(4'-bromobiphenyl-4-yl)-1,2,3,4-tetrahydro-1-naphthyl]-4-hydroxycoumarin

[iv] CAS # — 56073-10-0

[v] TYPE / MODE OF ACTION— An anticoagulant rodenticide.

2. USE PATTERN

This rodenticide is of exceptional activity against a variety of pest rodents. Effective against rodents resistant to conventional anticoagulants. Only single feeding is necessary for rodent death to occur.[2]

[i] APPLICATION — Grain-based bait pellets. Apply where rodents feed or congregate. Rodent may absorb lethal dose by taking only 50.0 mg/kg bait as part of food intake on only one occasion.[1]

[ii] RATES — For field application, apply 11.1 kg/ha of the 0.001 bait. A second 11.1 kg/ha application may be made about 2 weeks later.[1] Other applications include 25.0 µg/mouse or 0.1 mg/rat.

CARRIER: Not identified.

[iii] FORMULATIONS

1. SO, ready-to-use grain-base pellets contain 50 µl/L rodenticide.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable as solid under normal storage conditions. Keep containers closed to maintain bait freshness. Insoluble in water. Resists mould growth under damp conditions. Do not allow to contaminate food, feed or water supplies. Do not store together with organic phosphate spray materials as this reduces effectiveness of the chemical.

4. HANDLING PRECAUTIONS

Wash hands after handling bait. Avoid contact by mouth. Adequate protective clothing should be worn when handling.[1] After treatment remove and bury uneaten bait and rodent bodies. Do not re-use empty containers.[2]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Degraded in soils under aerobic and flooded conditions, unlikely to leach.[1]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Brodifacoum shows no loss in 30 days in direct sunlight.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	0.27 mg/kg		2
Rat	LD_{50} dermal	0.25-0.63 mg/kg		1
Rabbit	LD_{50} oral	0.3 mg/kg	Male rabbits	1
Cat	LD_{50} oral	c. 25.0 mg/kg		1
Dog	LD_{50} oral	0.25-1.0 mg/kg		1
Chicken	LD_{50} oral	4.5 mg/kg		1
Mallard	LD_{50} oral	2.0 mg/kg		1
Bluegill	LC_{50} 96h	0.165 mg/L		1
Rainbow trout	LC_{50} 96h	0.051 mg/L		1
Daphnia	*EC_{50} 48h*	*0.064 mg/L*		*1*

[i] TOXICITY (OTHER) — Relatively non-toxic to bird species. It is effective at such low rates that the risk of secondary poisoning to other animals is minimal.[3]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Brodifacoum is slow-acting, rodents die in 3-7 days. It has an acute, as well as chronic effect on rodents.[3] The chemical is highly lipid soluble and highly concentrated in the liver.[4] The half-life in dogs is 120 days and in rats is 156 hours. It is very difficult to extrapolate a half-life value for humans.[4]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Hoffman, R.S., M.J. Smilkstein and L.R. Goldfrank (1988) Evaluation of coagulation factor abnormalities in long-acting anticoagulant overdose. *Clinical Toxicology* 26: 233-248.
5. RRIP

Bromacil

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — bromacil (BSI, E-ISO, F-ISO, ANSI, WSSA, JMAF)

[ii] TRADE NAME — Hyvar X, Hyvar X-L (Dupont Canada Inc.)

[iii] CHEMICAL NAME — 5-bromo-3-*sec*-butyl-6-methyluracil

[iv] CAS # — 314-40-9

[v] TYPE / MODE OF ACTION— A substituted uracil compound used as a pre- and post-emergence herbicide.

2. USE PATTERN

Non-selective herbicide (weed and brush killer) on non-cropland and outdoor living areas for control of a wide range of annual and perennial grasses, broadleaf weeds, and certain woody species. Can be used to control brush as a spot treatment.[5]

[i] APPLICATION — Sprayed or spread dry (as granule, etc.) on soil surface, preferably just before or during period of active growth of weeds or applied directly on plants.

[ii] RATES — 1.7-5.6 kg/ha for general weed control. Controls most annuals. At 5.6-13.5 kg/ha, it controls many perennial weeds, grasses and woody species. At 13.4-26.9 kg/ha, it controls hard to kill perennials. 1.8-7.2 kg/ha.

CARRIER: Water, in sufficient volume for uniform coverage, oil solutions, or suspensions.

[iii] FORMULATIONS

1. WP
2. SN
3. PE
4. Miscible concentrates
5. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Active ingredient stable under normal storage conditions. Exposure of water-soluble formulations to air can cause some loss of water solubility. Non-corrosive. Alkaline liquid formulations should not be used with aluminum nozzles. Decomposed slowly by strong acids. Active ingredient and dry formulations are non-flammable; liquid (Hyvar-X-L) is combustible.

4. HANDLING PRECAUTIONS

Liquid formulation (Hyvar X-L) should be kept away from heat and open flame. Avoid drift. Do not use where it is likely to leach, wash or move with eroded soil into contact with roots of desirable species.[5] Do not plant any but tolerant crops for 2 years. Do not apply when ground is frozen. Do not use the same equipment to apply other pesticides. Avoid contact with skin, eyes and clothing. Avoid breathing dust or spray mist. Wash thoroughly after handling.

5. ENVIRONMENTAL PERSISTENCE

At higher rates usually persists more than one season; persistence equal to that of diuron.[5] Unstable on exposure to sunlight.[6]

[i] SOIL — Half-life in soil 5-6 months at 4.4 kg a.i./ha. Mobile in soil.[6] After 2 years continuous use, bromocil leached to a depth of 100 cm. Negligible loss from volatilization or photodecomposition. Much less subject to adsorption on soil colloids than many herbicides.[3] Microbial degradation involved in loss from soil. Soil diphtheroids, *Pseudomonas* and *Penicillium* involved.[3] Over 26 fungi representatives are involved in soil metabolism of bromacil.[6]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	5200 mg/kg		2
Rat	NOEL 2y	50.0 ppm		1
Rat	LD_{50} inhalation 4h	4.8 mg/L air		1
Rabbit	LD_{50} dermal	>5000 mg/kg		1
Dog	NOEL 1y	625 ppm		1
Mallard	LC_{50} dietary 8d	10,000 mg/kg		1
Bobwhite quail	LC_{50} oral	2250 mg/kg		1
Rainbow trout	LC_{50} 48h	56.0-75.0 mg/L		4
Bluegill	LC_{50} 48h	71.0 mg/L		4
Carp	LC_{50} 48h	164 mg/L		4
Fathead minnow	LC_{50} 96h	182 mg/L		4
Daphnia	*EC_{50} 48h*	*119 mg/L*		*1*
Mysid shrimp	LC_{50}	112.9 mg/L		1

[i] TOXICITY (OTHER) — Low toxicity to wildlife and fish.[3] Low toxicity to mammals.[3] WP and pellets: may irritate eyes, nose, throat and skin. WS liquid: harmful or fatal if swallowed.[3] No teratogenic effects have been observed. There is also no evidence of carcinogenicity. Although bromacil may be metabolized *in vivo* to the potent mutogen 5-bromouracil, it appears to be non-mutogenic and no 5-bromouracil has been detected as a metabolite in *in vitro* studies. Do not use near walnut trees.

[ii] PHYTOXICITY - Not identified.

7. METABOLISM

[i] ANIMAL — Bromacil is not excreted via the gastrointestinal tract of cows. In rats, the major metabolite excreted in the urine is 5-bromo-3-*sec*-butyl-6-hydroxymethyluracil.[6]

[ii] PLANT — Orange plants in sand containing 10.0 ug/kg took up >5% applied bromacil. In orange seedlings, bromacil was principal residue along with 5-bromo-3-*sec*-butyl-6-hydroxymethyl uracil and an unknown minor metabolite. No 5-bromouracil detected in plants or soil.[3]

8. ADDITIONAL INFORMATION

WS formulation incompatible with ammonium sulphamate, weed oil and liquid formulations of aminotriazine, and may be precipitated by pesticides containing soluble calcium salts. WP formulation requires continuous agitation to maintain suspension. Weed destruction rapid at recommended rates under minimal rainfall.[5] Particularly effective at 1.1-3.3 kg a.i./ha for annual control of all growth in combination with paraquat, sodium chlorate, or oils.[5]

9. REFERENCES

1. PM
2. FCH
3. HH
4. PP
5. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control*: Atlantic Supplement Edition. 101 pp.
6. (U.S.) Environmental Protection Agency Washington, DC Aug 88 Health Advisories for 50 Pesticides (Including Acifluorfen, Ametryn, Ammonium, Sulfamate Atrazine, Baygon, Bentazon, Bromacil, Butylate Carbaryl, Carboxin, Chloramben, Chlorothalonil Cyanazine, Dalapon, Dacthal, Diazinon, Dicamba 1,3-Dichloropropene, Dieldrin, Dimethrin, Dinoseb, Diphenamid, Disulfoton, Diuron, Endothall Ethylene Thiourea, Fenamiphos, Fluometuron Fonofos, Glyphosate, Hexazinone, Maleic Hydrazine MCPA, Methomyl, Methyl Parathion, Metolachlor, Metribuzin, Paraquat, Picloram, Prometon Pronamid, Propachlor, Propazine, Propham, Simazine, 2,4,5-T, Tebuthiuron, Terbacil, Terbufos and Trifluralin).

Bromadiolone

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — bromadiolone (BSI, E-ISO, F-ISO); broprodifacoum (Republic of South Africa).

[ii] TRADE NAME — Sanex Bromone (Sanex Agro Inc); Contrac (Bell Laboratories Inc.); Maki (LiphaTech Inc.); *Kemsan (Kemsan Inc.).* Other names include Boot Hill, *Vaporette,* Super-Caid, and Termus.

[iii] CHEMICAL NAME — 3-[3-(4'-bromobiphenyl-4-yl)-3-hydroxy-1-phenylpropyl]-4-hydroxycoumarin.

[iv] CAS # — 28772-56-7

[v] TYPE / MODE OF ACTION — Anticoagulant rodenticide. Also inhibits prothrombin formation.[1]

2. USE PATTERN

For the control of rats and mice.

[i] APPLICATION — Place bait in tamper-proof bait boxes in protected areas inaccessible to children, pets and livestock. Maintain an uninterrupted supply of fresh bait for 10-15 days. The first dead rodents will appear 4-5 days post-treatment. It has a single feeding mortality rate of 90%.

[ii] RATES — Finished baits contain 0.005% bromadiolone. One or two feedings will control a total population.

CARRIER: Pellet, solution, etc.

[iii] FORMULATIONS

1. PE
2. PT
3. SO
4. SN
5. GR
6. DV (tracking powder)

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Protect against extreme temperatures. Generally stable to hydrolysis.[3]

4. HANDLING PRECAUTIONS

Adequate protective clothing should be worn at all times.[4] When possible, toxic chemicals, concentrates and bait preparations should be handled in a fume cupboard. When bait mixing has been done in the field, operators should take care to remain sheltered from the wind.[4] Protective clothing should be removed and hands washed thoroughly with soap and hot water. Contaminated protective clothing must not be taken into "clean" areas. Smoking, eating and drinking must be strictly prohibited in all rooms in which poisons are present.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Leaching behaviour is inversely related to clay and organic matter content of soils.[1] Moderately persistent to persistent to aerobic soil degradation (half-lives of 26 to 178 days), can be considered immobile in soil and fairly insoluble in water.[3]

[ii] AQUATIC – Potential for Bromadiolone to reach ground water is generally low, reach surface waters through adsorption to eroding soil.[3]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1.125 mg/kg		2
Mouse	LD_{50} oral	1.75 mg/kg		1
Rabbit	LD_{50} oral	1.0 mg/kg		1
Quail	LD_{50} oral	1600 mg/kg	No other effects	1
Rainbow trout	LC_{50} 96h	1.4 mg/L		2

[i] TOXICITY (OTHER) — Non-toxic to fish. Poultry is sensitive to this chemical. Not hazardous to bees when used as directed.[1] Primary toxicity to mammals is very high. Toxicity to aquatic organisms is moderate to very high.[3]

[ii] PHYTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

No bait shyness occurs with this chemical.

9. REFERENCES

1. PM
2. FCH
3. USEPA. 1998. R.E.D. Facts: Bromadiolone. Prevention, Pesticides and Toxic Substances. EPA-738-F-98-004, July.
4. HSDB

Bromoxynil

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — bromoxynil (BSI, E-ISO, F-ISO, ANSI, WSSA)

[ii] TRADE NAME — Pardner, Bromox, Buctril M, *Torch, Sabre* (Rhone Poulenc Canada Inc.). Other names include Hoegrass and Brominal.

[iii] CHEMICAL NAME — 3,5-dibromo-4-hydroxybenzonitrile.

[iv] TYPE / MODE OF ACTION — Selective, contact, post-emergence herbicide. Octanaic and butyric acid esters are existing forms. Bromoxynil is absorbed by the foliage but not translocated. It inhibits photosynthesis and respiration, and is most active when weeds are growing rapidly.

2. USE PATTERN

For use on wheat, oats, rye, flax, barley, garlic, onions, mint, turf, corn, and sorghum. Controls such weeds as fiddleneck, dog fennel, torweed, mustards, nightshade, groundsel, shepherd's purse, and others. Established perennial weeds are not controlled.[2]

[i] APPLICATION — Ground and aerial foliage spray. Apply to cereals with fewer than 3-4 leaves. Apply to flax when 5-20 cm high. Apply to corn from the 3-leaf stage until it is 50 cm tall. Do not apply on crops stressed from lack of moisture. May be applied with liquid fertilizers. Older weeds may be controlled at a higher rate, if treated before flower formation.

[ii] RATES — 0.28-0.56 kg actual/ha in 23-114 L water.

CARRIER: Water, liquid fertilizer.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 23-25 m
2. Air blast application: Not identified.
3. 3. Aerial application: Calculated: 10-160 m
4. Forestry application: Not identified.

3. STORAGE

No deterioration in over 2 years storage time. This chemical is non-volatile, non-flammable and non-corrosive. The ester formulation flashes above 82°C, and solidifies below -20°C. It becomes usable again at temperatures above 0°C. Very stable to dilute alkalis and acids; stable to ultraviolet light.[1]

4. HANDLING PRECAUTIONS

Do not contaminate streams, lakes or ponds. Wash concentrate from hands or eyes immediately and wear rubber gloves while handling. Avoid breathing spray mist. Female workers are required to use nitrile gloves.[5]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Decomposed in soil with a half-life of 10 days. The loss of bromoxynil from sterile soil is negligible due to the lack of microbial action. Degraded by hydrolysis and debromination to less toxic substances such as hydrobenzoic acid.[1] Low persistence in soil.[1]

[ii] AQUATIC – If released into water, bromoxynil is not expected to adsorb to suspended solids and sediment based upon the estimated K_{oc}. Direct photolysis in sunlit surface waters is an important environmental fate process for bromoxynil. The presence of iron(III) or manganese(II), which are found in almost all natural waters, increases the photodegradation rate. Volatilization from water surfaces is not expected to be an important fate process since bromoxynil will exist almost entirely in the ionized form at pH values of 5 to 9.[6]

[iii] ATMOSPHERIC – If released to air bromoxynil will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase bromoxynil will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 76 days. Direct photolysis may occur in the atmosphere because it does photodegrade in water. Particulate-phase bromoxynil will be removed from the atmosphere by wet and dry deposition.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	190 mg/kg	Technical grade	4
Rat	LD_{50} oral	779 mg/kg	Buctril	4
Rat	LD_{50} dermal	>2000 mg/kg		1
Mouse	LD_{50} oral	110 mg/kg		1
Rabbit	LD_{50} dermal	3660 mg/kg		1
Pheasant	LD_{50} oral	50.0 mg/kg		1
Mallard	LD_{50} oral	200 mg/kg		3
Quail	LD_{50} oral	100-125 mg/kg		1
Hen	LD_{50}	240 mg/kg		4
Rainbow trout	LC_{50}	0.15 mg/L	Octanoate formulation	1
Goldfish	LC_{50} 48h	0.46 mg/L		1
Catfish	LC_{50} 48h	0.063 mg/L		1
Harlequin fish	LC_{50} 48h	5.0 mg/L	Potassium salt	4
Daphnia	*LC_{50}*	*0.01 mg/L*		*3*

[i] TOXICITY (OTHER) — Toxic to fish[2] and wildlife. Highly toxic to moderately toxic to freshwater fish.[1] Oral administration to pregnant rats increased the incidence of major and minor fetal malformations. There is thus a danger of occupational exposure to women of child-bearing age. Bromoxynil causes a mild and temporary reaction in the eyes. Not toxic to bees.[1] Does not cause reproductive effects.[1]

[ii] PHYTOTOXICITY — Filaree and chickweed are tolerant to this compound.[2]

7. METABOLISM

[i] ANIMAL – Metabolism is by hydrolysis of the ester and nitrile groups, with some debromination occurring.[1]

[ii] PLANT - In plants, this compound may be hydrolyzed to benzoic acid.

8. ADDITIONAL INFORMATION

Bromoxynil salts are suitable for use in hard water. It should not be mixed with other pesticides without first making a compatability test. Octanoate and butyrate formulations have a greater dermal absorption rate.

9. REFERENCES

1. PM
2. AC
3. HH
4. PP
5. Pesticide and Toxic Chemical News. May 10, 1989. Bromoxynil relabeled; exposure data requirements imposed. p. 29-30.
6. HSDB

Butylate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — butylate (BSI, E-ISO, WSSA); butilate (F-ISO); exception (FRG)

[ii] TRADE NAME — Sutan (Zeneca Inc.)

[iii] CHEMICAL NAME — *S*-ethyl di-isobutylthiocarbamate

[iv] CAS # — 2008-41-5

[v] TYPE / MODE OF ACTION — Selective systemic herbicide. Inhibits meristematic growth.[1]

2. USE PATTERN

This pre-plant herbicide controls most grass weeds, including wetgrass, in corn and can be used in field applications for food and feed crops. Should not be applied on milo, sorghum, or corn seed stock.

[i] APPLICATION — Incorporated pre-plant. Apply to dry surface only. Incorporate 7.5-15.0 cm deep using discs or power tiller followed by spike harrow. Must be incorporated immediately; forms gas on contact with soil.

[ii] RATES — 3.3-4.4 kg a.i./ha alone or with 0.57-0.91 kg atrazine. 3.0 kg a.i./ha for control of annual weeds. 4.0 kg. a.i./ha (or 3.0 kg/ha + 1.0 kg 2,4-D/ha) for additional control of broadleaf weeds.

CARRIER: Water, 187-935 L/ha of total liquid.

[iii] FORMULATIONS

1. GR
2. EC
3. MS

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 0 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Apparently indefinite under normal ambient conditions. Photosensitivity is indeterminate. Non-corrosive. Flash point 110°C. Thermally stable up to 200°C; hydrolysed by strong acids and alkalis, and in aqueous solution in sunlight.[1]

4. HANDLING PRECAUTIONS

Do not apply before pre-irrigation. Do not use on hybrid corn for seed. Protective personal equipment includes: safety glasses, goggles, or faceshield; impervious gloves and apron.[5]

5. ENVIRONMENTAL PERSISTENCE

Breaks down relatively soon and is harmless to crops following corn. Disappears from stems and leaves of corn plants in 7-14 days.

[i] SOIL — Butylate is rapidly degraded in soils with a half life of 1.5-3 weeks under crop growing conditions.[3] It is slightly to highly mobile, depending on soil type. High volatilization. Microbial action is important in the disappearance of butylate from soil.

[ii] AQUATIC – If released into water, butylate is expected to adsorb to suspended solids and sediment based upon the experimental K_{oc}. Volatilization from water surfaces is expected to be an important fate process.[5]

[iii] ATMOSPHERIC - If released to air butylate will exist solely as a vapor in the ambient atmosphere. Vapor-phase butylate will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 13 hours.[5]

[iv] PHYTODEGRADATION — Rapidly metabolized in corn roots and leaves to CO_2, disbutylamine, fatty acids, conjugates of amines and fatty acids, and certain natural plant constituents.[3]

[v] OTHER – Non-mutagenic and non-carcinogenic. Unlikely to cause teratogenic effects in humans under normal circunmstances.[4]

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>3500 mg/kg		1
Rat	LD_{50} oral	3500-5431 mg/kg	Technical grade	2
Rat	NOEL 90d	32.0 mg/kg/d		1
Rabbit	LD_{50} dermal	>4640 mg/kg		2
Dog	NOEL 90d	40.0 mg/kg/d		1
Bobwhite quail	LC_{50} dietary 7d	40,000 mg/kg diet		1
Rainbow trout	LC_{50} 96h	4.2 mg/L		4
Bluegill	LC_{50} 96h	6.9 mg/L		1

[i] TOXICITY (OTHER) — In 90-day feeding trials 40.0 mg/kg daily was well tolerated by rats and dogs. Not hazardous to bees when used as directed.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In rats, within 24 hours 60.9-64.0% is expired as CO_2; 27.3-31.5% excreted in the urine and 3.3-4.7% in the faeces at dosage rates of 12.3 and 156 mg/kg.

[ii] PLANT – Rapidly metabolized in plants to CO_2, disobutylamine, fatty acids, conjugates of amines and fatty acids, and naturally occurring plant constituents.[1]

8. ADDITIONAL INFORMATION

Closely related to EPTC. Six weeks control can be expected. No soil carry-over problems. No contact activity. No known incompatibilities.

9. REFERENCES

1. PM
2. FCH
3. HH
4. PP
5. HSDB

Captan

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — captan (BSI, E-ISO, JMAF); captane (F-ISO); captab (Republic of South Africa)

[ii] TRADE NAME — Captan (Arvesta Corporation, United Agri Products); Agrox D-L Plus (Norac Concepts Inc.); Maestro (Arvesta Corporation). Other names include Orthocide 406, Merpan, and Vondcaptan SR406.

[iii] CHEMICAL NAME — *N*-(trichloromethylthio)cyclohex-4-ene-1,2-dicarboximide

[iv] CAS # — 133-06-2

[v] TYPE / MODE OF ACTION — Non-systemic fungicide with protective and curative action.[1] Inhibits pyruvate carboxylase.[5]

2. USE PATTERN

Controls a wide range of fungal pathogens causing downy mildew, brown rot, anthracnose, and leaf spot in vegetable and fruit crops such as celery, cucumber, tomato, apple, pear, blueberry. Used as a seed treatment in maize. Also used in greenhouses for ornamentals.

[i] APPLICATION — May be applied before and after disease symptoms appear. Can be tank-mixed with other fungicides to control apple scab.[4] Applied as a foliar spray, planter box seed treatment, post-harvest spray or dip, pre-plant soil treatment, and as a potato seed piece dip. Compatible with most pesticides but cannot be used with alkaline and oil sprays.[5]

[ii] RATES — Apple, pear, cherry, 0.5-1.2 kg a.i./1000 L water. Vegetable crops, 1.875-3.375 kg a.i./ha. Maize (seed treatment), 3.75 g a.i./ kg seed. Ornamentals, 0.975-7.5 kg/1000 L water.[4]

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. DU
3. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 22-28 m
2. Air blast application: Calculated: 22(32)-28(38) m
3. Aerial application: Calculated: 200-540 m
4. Forestry application: Not identified.

3. STORAGE

Stable except under alkaline conditions. Non-corrosive, but decomposition products corrosive. Incompatible with alkaline materials, oil sprays, TEPP, and emulsifiable concentrate formulations of parathion.[1]

4. HANDLING PRECAUTIONS

Do not use treated seed for food or feed. Do not apply within 7 days of harvest in apple and pear. Personnel protection equipment required includes: appropriate chemical protective gloves and boots to prevent skin contact, and goggles to prevent eye contact.[5] Wash hands and face thoroughly with soap and water after use and before eating or smoking.[5] Avoid breathing vapors or dusts. Wash away any material which may have contacted the body with copious amounts of water or soap and water.[5]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Moderate persistence in soil (half-life 1-12 days in moist soil).[5] If well distributed in soil then half-life is 1 to 2 days. Not expected to leach.

[ii] AQUATIC — The persistence in fresh water at near-neutral pH is short due to rapid hydrolysis. Half-lives are on the order of hours.[5] Effective residual life in water is 2 weeks.[7] Moderate tendency to sorb to sediment and biota and low to medium tendency to bioconcentrate.[5]

[iii] ATMOSPHERIC – If released to air captan will exist predominantly in the particulate phase in the ambient atmosphere. Particulate-phase captan will be removed from the atmosphere by wet and dry deposition.[5]

[iv] PHYTODEGRADATION — Fungicidal effects last from 3-7 days. Residual fungitoxicity remains for 23 days on

potato leaves.[7] Residues remaining on strawberries and grapes at harvest have been found to be very low (<0.01-1.5 µl/L on strawberries and <0.01-0.082 µl/L on grapes).[8] In greenhouse tomatoes, only a very small amount enters the cuticle, therefore the amount of chemical on the surface is effectively reduced by dilution and mechanical removal.[3]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	9000 mg/kg		2
Rat	LD_{50} oral	8400-15000 mg/kg		7
Mouse	LD_{50} oral	7000 mg/kg		7
Rabbit	LD_{50} dermal	>4500 mg/kg		5
Dog	NOEL 2y	4000 mg/kg diet		1
Human	ADI	0.1 mg/kg b.w.		1
Bobwhite quail	LD_{50} oral	2000-4000 mg/kg		7
Mallard	LD_{50} oral	5000 mg/kg		7
Japanese quail	LD_{50} oral	>5000 mg/kg		5
Bluegill sunfish	LC_{50} 96h	0.072 mg/L		1
Harlequin fish	LC_{50} 96h	0.3 mg/L		1
Brook trout	LC_{50} 96h	0.034 mg/L		1
Rainbow trout	LC_{50} 96h	0.066-0.08 ppm		2
Chinook salmon	LC_{50} 96h	0.056 mg/L	Technical grade	7
Lake trout	LC_{50} 96h	0.049 mg/L	Static bioassay	6
Yellow perch	LC_{50} 96h	0.12 mg/L	Technical grade	5
Daphnia	*LC_{50} 48h*	*7.06-9.96 ppm*		*6*

[i] TOXICITY (OTHER) — Low acute toxicity to warm-blooded animals. May cause skin irritation. Non-toxic to honeybees, earthworms, birds. Moderately toxic to aquatic invertebrates.[1] Very highly toxic to fish.[1] No carcinogenic, teratogenic or mutagenic effects have been observed.[1]

[ii] PHYTOTOXICITY — May cause leaf and fruit injury if applied following a summer oil combination. When applied at high rates or in drenching sprays, may cause necrotic spotting in immature leaves of apple, pear, and cherry.[4]

7. METABOLISM

[i] ANIMAL – Rapidly absorbed from the gut and metabolized.[9] Virtually all of captan and its metabolites are eliminated within 3-4 days.[10] Approx. 52% eliminated in the urine, 23% expired in air and 16% in the faeces.[10] Metabolites include trithiocarbamate, thiophosgene, and tetrahydrophthalidimide.[1]

[ii] PLANT – Taken up through the leaves and roots and translocated throughout the plant. Residual fungitoxicity remains for 23 days after application on potatoe leaves, but residues were below the detection limit within 40 days after application.[7]

8. ADDITIONAL INFORMATION

Used as a fungicide in paints, plastics, leather, etc. Acts as safener for lead arsenate but not calcium arsenate.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. CESARS
7. PP
8. Gilvydis, D.M. et. al. (1986) Residues of Captan and Folpet in strawberries and grapes. *J. Assoc. Off. Anal. Chem.*, 69: 803-806.
9. Vettorazzi, G. (1977) State of the art of the toxicological evaluation carried out by the Joint WHO/FAO Expert Committee on Pesticide Residues. III. Miscellaneous pesticides used in agriculture and public health. *Residue Reviews*, 66: 137-184.
10. Captan: Environmental Fate and Effects on non-target organisms. Feb. 5, 1982. Contaminants Control Branch, EPS E.C.

Carbaryl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — carbaryl (BSI, E-ISO, F-ISO, ANSI, ESA, BAN); NAC (JMAF); sevin (former exception, USSR).

[ii] TRADE NAMES — Sevin and Sevimol (Rhone Poulenc Canada Inc.) are registered in Canada. Other names include Carbamec (PBI-Gordon), Savit (Griffin), Carbamine, Denapon, Dicarbam, Hexavin, Karbaspray, Nac, Rayvon, Septene, Tercyl, and Tricarnam.

[iii] CHEMICAL NAME — 1-napthyl methylcarbamate

[iv] CAS # — 63-25-2

[v] TYPE / MODE OF ACTION — A carbamate insecticide and acaricide with contact and stomach action. Weak cholinesterase inhibitor. Can also be used a plant growth regulator.[1]

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Broad spectrum insecticide, used on more than 120 different crops including fruits, field and vegetable crops, forests, lawns, rangeland, and ornamental trees (forage crops, nuts, shade trees), to control Lepidoptera, Coleoptera, and other chewing and sucking insects.[1] Also used on livestock, poultry and pets.[5] Compatible with maneb, malathion, propanil, and lindane.[1]

[i] APPLICATION — With common application equipment at uniform rate. Apply when insects first appear and repeat as necessary. On livestock, do not use more often than every 4 days. Used as dust and suspension on poultry, cats and dogs, and in flea collars on cats and dogs.

[ii] RATES — Field crops, 0.6-3.072 kg a.i./ha. Corn, 1.2-1.92 kg a.i./ha. Vegetable crops, 0.6-1.2 kg a.i./ha. Tree fruit, 0.576-1.10 kg a.i./ha in 1000 L water (dilute spray).[4]

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. DU
3. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 79-86 m
2. Air blast application:	Calculated: 75(86)-89(100) m
3. Aerial application:	Calcualted: >1000 m
4. Forestry application:	Calculated: >1000 m

3. STORAGE

Stable to light, heat and hydrolysis under normal storage conditions. Non-corrosive.

4. HANDLING PRECAUTIONS

Compatible with most other pesticides unless strongly alkaline, *e.g.*, Bordeaux mixture or lime sulphur, which hydrolyze it to 1-napthol.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Low soil persistence. Degradation mainly by sunlight and bacterial action.[7] Half-life of 7-14 days (sandy loam soil) and 14-28 days (clay loam soil).[1] Undergoes rapid hydrolysis in moist alkaline soil.[5] Moderate sorption to soil particles.

[ii] AQUATIC — Temperature, light and pH affect rate of degradation; hydrolysis more rapid in alkaline water.[8] Half-life at neutral pH is 10 days.[7] Bioconcentration is not expected to be significant.

[iii] ATMOSPHERIC — Removal by direct photolysis and reaction with hydroxyl radicals. Half-life of vapour phase carbaryl is about 12.6 hours.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified

6. TOXICITY

Animal	Test	Dose	Comments	Ref.
Rat	LD_{50} oral	250-850 mg/kg		7
Rat	LD_{50} oral	500 mg/kg	Female rats	1
Rat	NOEL 2y	200 mg/kg		1
Mouse	LD_{50} oral	100-650 mg/kg		7
Rabbit	LD_{50} oral	710 mg/kg		6
Rabbit	LD_{50} dermal	>2000 mg/kg		7
Human	ADI	0.01 mg/kg b.w.		1
Mallard	LD_{50} oral	>2179 mg/kg	1-month old females	6
Canada goose	LD_{50} oral	1790 mg/kg		6
Japanese quail	LD_{50} oral	2230 mg/kg		1
Pigeon	LD_{50} oral	1000-3000 mg/kg		1
Pheasant	LD_{50} oral	>2000 mg/kg		7
Sharp-tailed grouse	LD_{50} oral	780-1700 mg/kg	Females	7
Rainbow trout	LC_{50} 96h	0.935-1.74 mg/L		6
Sheepshead minnow	LC_{50} 96h	2.2 mg/L		1
Bluegill sunfish	LC_{50} 96h	10.0 mg/L		7
Coho salmon	LC_{50} 96h	4.34 mg/L	Static bioassay	5
Carp	LC_{50} 96h	5.28 mg/L	Static bioassay	5
Goldfish	LC_{50} 24h	28.0 mg/L		2
Yellow perch	LC_{50} 96h	5.1 mg/L	Static bioassay	5
Gammarus lacustris	LC_{50} 24h	0.04 µl/L		8
Gammarus lacustris	LC_{50} 48h	0.022 µl/L		8
Mysid shrimp	LC_{50} 96h	5.7 mg/L		1
Crayfish	LC_{50} 96h	1.9 mg/L	Technical grade	5
Daphnia	*EC_{50} 48h*	*0.006 mg/L*		*1*

[i] TOXICITY (OTHER) — Cholinesterase inhibitor. Mammals moderately affected by acute dose levels.[8] In mammals, carbaryl does not accumulate in tissue and is metabolized rapidly.[1] Low toxicity to birds. Toxic to bees (LD_{50} topical 1.0 µg/bee) and beneficial insects.[1] Biomass and number of non-target invertebrates temporarily reduced after acute exposure.[8] Subacute/chronic effects observed include changes in liver function and effects on reproduction (infertility, fetotoxicity, teratogenesis) in various species.[8]

[ii] PHYTOTOXICITY — Little or none.[8] Excessive doses may retard grass germination. Injury may occur to tender foliage in presence of rain or high humidity for several days. Injury reported on McIntosh and York apples, watermelon and Boston ivy.[3]

7. METABOLISM

[i] ANIMAL - Metabolites such as 1-naphthol and glucaronic acid conjugate are eliminated in urine and faeces. Up to 85% of carbaryl is eliminated within 24 hours of administration.[7]

[i] PLANT – Degradation of carbaryl in crops occurs by hydrolysis inside the plants. It has a short residual life of less than 2 weeks. The breakdown of the substance is strongly dependant on acidity and temperature.[7]

8. ADDITIONAL INFORMATION

Control should last for one to three weeks.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. CESARS
7. PP
8. Mount, M.E. and F.W. Oehme (1981) Carbaryl: a literature review. *Residue Reviews*, 80: 1-64.

Carbathiin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — carboxin (BSI, E-ISO, ANSI); carboxine (F-ISO); carbathiin (Canada); exceptions (Denmark, FRG)

[ii] TRADE NAME — Vitavax, Anchor, Vitaflo-280, Arrest (Uniroyal Chemical Ltd.)

[iii] CHEMICAL NAME — 5,6-dihydro-2-methyl-1,4-oxathi-ine-3-carboxanilide.

[iv] CAS # — 5234-68-4

[v] TYPE / MODE OF ACTION — An organic compound effective as a systemic fungicide. May inhibit mitochondrial respiration.[5]

2. USE PATTERN

For use as a seed treatment for cereals, nuts, and vegetables. It is effective against smuts, bunts, *Rhizoctonia* spp., damp off, loose-smut, sore skin, flag smut, common bunt and others. Compatible with most pesticides including maneb, lindane, and captan, except those which are highly acidic or alkaline.[1]

[i] APPLICATION — Applied as a seed treatment. May be mixed with many commonly used pesticides used as seed treatments.[3]

[ii] RATES — Wheat, barley, oats, 11.0-19.0 g a.i./25 kg seed. Corn, 10.43 mL a.i./25 kg seed. Soybeans, 9.69 mL a.i./25 kg seed.[4]

CARRIER : Not identified.

[iii] FORMULATIONS

1. SN
2. DU
3. SU
4. WP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store product in original container only, away from other pesticides, fertilizer, food or feed. Keep container closed.[4] Stable to hydrolysis at pH 5, 7 and 9.[1]

4. HANDLING PRECAUTIONS

This chemical is corrosive. Treated seed should not be used for food or feed. Treated seed must be labeled. Work in a well-ventilated area and wear rubber gloves and protective eye wear. Not compatible with pesticides which are highly alkaline or acidic.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Low persistence in soil (Half-life ~ 3 days).[7] Rapidly degraded to carboxin sulfoxide. Both parent compound and sulfoxide may leach to groundwater.[7]

[ii] AQUATIC — Degradation by algae. Undergoes oxidation to sulfoxide and sulfone within 7 days.[7] Essentially non-volatile if released to water.[5]

[iii] ATMOSPHERIC — Reacts with hydroxyl radicals (Half-life ~2.4 days) and atmospheric ozone (Half-life ~ 1 day).[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	3820 mg/kg		5
Rat	NOEL 2y	600 mg/kg diet	No ill-effects	1
Mouse	LD$_{50}$ oral	3200 mg/kg		6
Rabbit	LC$_{50}$ dermal	>8000 mg/kg		2
Mallard	LC$_{50}$ dietary 8d	>4640 mg/kg diet		5
Quail	LC$_{50}$ dietary 8d	>10,000 mg/kg diet		1
Bluegill	LC$_{50}$ 96 h	1.2 mg/L		6
Rainbow trout	LC$_{50}$ 96 h	2.0 mg/L		1
Crayfish	LC$_{50}$	217 mg/L		7
Daphnia	*LC$_{50}$ 48 h*	*84.4 mg/L*		*6*
Chlorella	*EC$_{50}$ 96h*	*2.4 mg/L*		*1*

[i] TOXICITY (OTHER) — Causes eye irritation, produces very little skin irritation.[7] Toxic to fish.[3] Not hazardous to bees when used as directed.[1] Non-teratogenic, non-mutagenic, unlikely to produce reproductive effects in humans at expected exposure levels.[7]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.[3]

7. METABOLISM

[i] ANIMAL – Rats excreted almost all of a carboxin dose in 24 hours, with most excreted in urine and some in faeces; compound does not accumulate in animal tissues.[7]

[ii] PLANT – Undergoes oxidation to the sulfoxide, but not further to the sulfone.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. CESARS
7. PP

Carbofuran

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — carbofuran (BSI, E-ISO, F-ISO, ANSI, ESA)

[ii] TRADE NAME — Furadan (Bayer Inc Ag. Div., FMC Corp.)

[iii] CHEMICAL NAME — 2,3-dihydro-2,2-dimethylbenzofuran-7-yl methylcarbamate

[iv] CAS # — 1563-66-2

[v] TYPE / MODE OF ACTION — Broad spectrum carbamate insecticide and nematicide with stomach and contact action. Cholinesterase inhibitor.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Controls soil-dwelling and foliar-feeding insects (such as Colorado potato beetle and wireworms) and nematodes in certain vegetable and field crops such as maize, potatoes, tobacco, and sunflowers. Not compatible with alkaline pesticides.[1]

[i] APPLICATION — Apply when insects reach threshold level. May be applied by air. Not for use on field and silage corn in Eastern Canada.[3] Broadcast for control of nematodes. Apply to foliage of crops.

[ii] RATES — Potato, 0.26-0.53 kg a.i./ha in 800-1000 L water. Sweet corn, 0.24-0.53 kg a.i./ha.[3]

CARRIER: Water.

[iii] FORMULATIONS

1. GR
2. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0-5 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 5-35 m
4. Forestry application: Not identified.

3. STORAGE

Non-flammable, but will support combustion if ignited. Non-corrosive. Do not store under 2°C.

4. HANDLING PRECAUTIONS

When using Furadan, goggles and recommended mask and respirator should be worn to avoid exposure. Exposed granules at the ends of rows should be disked into the soil. Birds feeding in the area may be killed. Avoid spray drift. Make no more than two applications in any season.[3] Incompatible with alkaline materials.[1] Avoid breathing dusts, and fumes from burning material. Keep upwind. Avoid bodily contact with the material. Wash away any material which may have contacted the body with copious amounts of water or soap and water.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Moderately persistent in soil (Half-life ~30-120 days).[5] Important metabolite is carbon dioxide formed from microbial degradation of phenol ring.[1] Highly mobile in sandy loam soils.[5] Not expected to volatilize.[4]

[ii] AQUATIC — Subject to hydrolysis under alkaline conditions. Half-life in lake water is about 6 hours.[4] Microbial degradation may also be important. No expected bioconcentration. High potential for groundwater contamination.[5]

[iii] ATMOSPHERIC - If released to the atmosphere, carbofuran should exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase carbofuran is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals with a half-life of about 13 hours. Particulate phase carbofuran may be physically removed from the air by wet and dry deposition. Direct photolysis may be an important removal process for carbofuran in the atmosphere.[4]

[iv] PHYTODEGRADATION — Quickly metabolized to 3-hydroxycarbofuran and ketocarbofuran.[1] Half-life on crops is about 4 days.[5]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	5.0-13.0 mg/kg		5
Mouse	LD_{50} oral	14.4 mg/kg		1
Rabbit	LD_{50} dermal	>1000 mg/kg		5
Dog	LD_{50} oral	15.0 mg/kg		1
Dog	NOEL 1y	10.0 mg/kg diet		1
Human	ADI	0.01 mg/kg b.w.		1
Mallard	LD_{50}	0.48-0.51 mg/kg		5
Chicken	LD_{50}	25.0-39.0 mg/kg		2
Bobwhite quail	LD_{50}	12.0 mg/kg		5
Japanese quail	LD_{50} oral	2.5-5.0 mg/kg		1
Pheasant	LD_{50}	4.15 mg/kg		5
Coho salmon	LC_{50} 96h	0.53 mg/L		4
Rainbow trout	LC_{50} 96h	0.38 mg/L		4
Bluegill	LC_{50} 96h	0.24 mg/L		4
Fathead minnow	LC_{50} 96h	0.872 mg/L		4
Yellow perch	LC_{50} 96h	0.147 mg/L		4
Daphnia	*EC_{50} 48h*	*0.015 mg/L*		*1*

[i] TOXICITY (OTHER) — Toxic to birds, fish, wildlife. Highly toxic to bees (except for granular formulations). Not readily absorbed by skin. Mildly irritating to eyes and skin in rabbits.[1] Unlikely to cause reproductive effects in humans at expected exposure levels; non-teratogenic, non-mutagenic.[5]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL - Metabolized by hydrolysis and oxidation in the rat. 72% of carbofuran is excreted in the urine within 24 hours. Major metabolite was conjugated 3-keto carbofuran phenol.[1] Not accumulated in tissue.

[ii] PLANT – Carbofuran is quickly metabolized into 3-hydroxycarbofuran and ketocarbofuran.[1]

8. ADDITIONAL INFORMATION

May be tank mixed and applied with liquid fertilizers. As of 1994, USEPA has banned the use of granular forms of carbofuran due to their toxicity to birds.[3]

9. REFERENCES

1. PM
2. FCH
3. PMRA
4. HSDB
5. PP

Chinomethionat

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chinomethionat (E-ISO); chinomethionate (F-ISO); quinomethionate (BSI); oxythioquinox (Australia, ESA); quinoxalines (JMAF); exception (USA)

[ii] TRADE NAME — Morestan (Bayer Inc. Ag. Div.)

[iii] CHEMICAL NAME — 6-methyl-1,3-dithiolo [4,5-*b*] quinoxalin-2-one

[iv] CAS # — 2439-01-2

[v] TYPE / MODE OF ACTION — A hydrocarbon used as a contact insecticide, acaricide, and fungicide.[1]

2. USE PATTERN

For residual control of powdery mildew, mites, mite eggs, pear psylla, white flies, and aphids on deciduous fruits, non-bearing strawberries, and ornamentals.

[i] APPLICATION — Apply during good drying conditions. Do not apply with a spreader-sticker. Should be applied before mites and eggs are present in large numbers and before mites cause bronzing of the foliage.

[ii] RATES — The wettable powder formulation is applied at a rate of 156-500 g a.i./ha. The dust formulation is applied at a rate of 13.0-170 g a.i./ha.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. DU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Calcualted: 0-4(8) m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Relatively stable under normal conditions. Hydrolysed in alkaline media.[1]

4. HANDLING PRECAUTIONS

Do not graze treated areas. Do not apply in combinations with oils after the delayed dormant stage when this material is to be used in the pink stage. Do not contaminate streams, lakes or ponds. Incompatible with mineral oils, and with formulations based on thiram.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – If released to soil or natural waters this compound will volatilize slowly from water and moist soil surfaces. Chinomethionat absorbs strongly to soil. In alkaline solution chinomethionat is expected to hydrolyze to 6-methyl-2,3-quinoxalinedithiol. Chinomethionat will photolyze giving dimethylthieno(2,3-b:4,5-b')diquinoxaline, dimethyl-p-dithiino(2,3-b:5,6-b')diquinoxaline, and elemental sulfur as photoproducts. Bioconcentration is not a major fate process for this compound.[4]

[ii] AQUATIC – Will volatilize slowly from water surfaces.[4]

[iii] ATMOSPHERIC – When released to the atmosphere chinomethionat will degrade in the vapor-phase by reaction with photochemically produced hydroxyl radicals (Half-life ~5 days). Particulate-phase chinomethionat and aerosols released to air during spray applications of oxythioquinox pesticides will be removed from air physically by dry and wet deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	2541 mg/kg	Male rats	1
Rat	LD_{50} oral	1095 mg/kg	Female rats	1
Rat	LD_{50} dermal	>2000 mg/kg	No ill effect	2
Dog	NOEL 1y	25.0 mg/kg diet		1
Bobwhite quail	LD_{50} oral	196 mg/kg		1
Mallard	LC_{50} dietary 5d	>5000 mg/kg diet		1
Rainbow trout	LC_{50} 96h	0.131 mg/L		1
Bluegill sunfish	LC_{50} 96h	0.0334 mg/L		1
Daphnia	*EC_{50} 48h*	*0.12 mg/L*		*1*

[i] TOXICITY (OTHER) — Non-toxic to honeybees. Toxic to fish. May cause skin irritation, but is not a skin sensitizer. Harmful to humans if absorbed through the skin. Non-mutagenic.[4]

[ii] PHYTOTOXICITY — Some phytotoxicity may occur in late spring or summer applications when used in conjunction with most fungicides and pesticides. Phytotoxic when mixed with oils. Injury has been reported on delicious and winesap apples, D'Anjou pears, and some varieties of roses, alders, and other ornamentals. Injury is most likely to occur if the foliage is wet for a prolonged period of time after application.[3]

7. METABOLISM

[i] ANIMAL – In orally administered rats, chinomethionat is rapidly metabolized, and approximately 90% is eliminated within 3 days in the faeces and urine.[1]

[ii] PLANT – After application to fruit, no penetration of the A.I. or metaboliotes in the fruit pulp was observed.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HSDB

Chlormequat chloride

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chlormequat chloride (BSI, E-ISO, F-ISO)

[ii] TRADE NAME — Cycocel (Cyanamid Crop Protection); Cycocel Extra (BASF Canada Inc.)

[iii] CHEMICAL NAME — 2-chloroethyltrimethylammonium

[iv] CAS # — 999-81-5

[v] TYPE / MODE OF ACTION — A chlorinated hydrocarbon used as a plant growth regulator. Inhibits cell elongation to shorten and straighten plant stems to produce a sturdier plant.[1] Activity is opposite to that of gibberellic acid, causing compactness and richer colour.

2. USE PATTERN

Used to strengthen the stem of oats, rye, wheat and poinsettias, and to increase flowering and harvest of pears and tomatoes. Also used to make more compact and earlier budding plants with greater symmetry, improved color, and increased root systems for a greater yield under dry conditions. Effective on ornamentals.

[i] APPLICATION — Apply as a soil drench during the period of active root growth. To small grains apply at the time of tillering, before jointing. May be applied after panning 5.7-7.6 cm stock, or after pinching plants and up to 1 week thereafter. Do not apply when crop is wet or if rain is expected within 4 hours. May be mixed with other pesticides. Used as a spray when crops are growing normally, and not when crop is under stress from prolonged cold weather, poor fertility, or other factors.

[ii] RATES — Apply to small grains at a rate of 1.25-3.0 kg a.i./ha; 1:40 with water. 0.16-0.65 mL a.i./pot.

CARRIER: Water.

[iii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

2. Ground application: Calculated: 0 m
3. Air blast application: Not identified.
4. Aerial application: Not identified.
5. Forestry application: Not identified.

3. STORAGE

Do not store below freezing. Corrosive if left in tanks for a long period of time. Store in container of glass, high density plastic, or metal lined with rubber or epoxy resin. Extremely hygroscopic; aqueous solutions are stable. Decomposes at 245°C.[1] Stable up to 50 deg C for at least 2 years.[4]

4. HANDLING PRECAUTIONS

Wear protective clothing and impermeable gloves.[4] Inhalation of spray and prolonged or repeated contact with skin should be avoided. Clothing should be removed and washed thoroughly after handling the chemical. Over-dosages may over-dwarf plants.[3] Should not be combined with dinoseb, cyanazine, or other contact herbicides.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Non-volatile. This chemical is rapidly degraded in soil by enzyme activity and there is no influence on soil microflora or fauna.[1] It persists for less than one season.[3]

[ii] AQUATIC – In water, adsorption and biodegradation will be the primary removal processes. Chlormequat chloride is a quaternary ammonium compound which exists as a cation in water and moist soils; it is expected to strongly adsorb to various materials, including suspended solids in wastewater treatment facilities, sediments in rivers and lakes, suspended organics and minerals in natural water systems, clays, proteins, and microorganisms.[4]

[iii] ATMOSPHERIC – If released to the atmosphere, chlormequat chloride will exist in the vapor and particulate phases. Vapor phase chlormequat chloride will degrade slowly by reaction with photochemically produced hydroxyl radicals (half-life of about 12 days). Particulate phase cycocel will be physically removed from air by dry deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	966 mg/kg	Male rats	1
Rat	LD_{50} oral	807 mg/kg	Female rats	1
Rat	LD_{50} dermal	>4000 mg/kg		2
Rat	NOEL 2y F.T.	50.0 mg/kg b.w.		1
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Human	ADI	0.05 mg/kg b.w.		1
Chicken	LD_{50} oral	920 mg/kg		1
Japanese quail	LD_{50} oral	555 mg/kg		1
Pheasant	LD_{50} oral	261 mg/kg		1
Rainbow trout	LC_{50} 96h	>1000 mg/L		1
Fiddler crab	LC_{50} 96h	>1000 mg/L		1
Daphnia	*EC_{50} 48h*	*16.9 mg/L*		*1*

[i] TOXICITY (OTHER) – Non-toxic to bees.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In goats, 97% is eliminated within 24 hours, principally unchanged.[1]

[ii] PLANT – Converted to choline chloride in most plants studied.[1]

8. ADDITIONAL INFORMATION

The toxicity of chlormequat chloride to mammals is reduced by the addition of choline chloride.[1]

9. REFERENCES

1. PM
2. FCH
3. AC
4. HSDB

Chloroneb

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chloroneb (BSI, E-ISO, ANSI); chloronebe (F-ISO)

[ii] TRADE NAME — Terraneb (Kincaid Enterprises Inc.); Scotts Proturf (The Scotts Company)

[iii] CHEMICAL NAME — 1,4-dichloro-2,5-dimethoxybenzene

[iv] CAS # — 2675-77-6

[v] TYPE / MODE OF ACTION — A chlorinated aromatic hydrocarbon used as a systemic fungicide. Absorbed by roots, chloroneb concentrates in roots and lower stems rendering these plant parts fungistatic.[1]

2. USE PATTERN

For the treatment of snow mold and blight on turfgrass, as well as the systemic control of seedling diseases of beans and soybeans. Also used as a supplemental seed treatment for sugar beets.

[i] APPLICATION — As a supplemental seed treatment, apply as a seed overcoating to standard treatment seed or mix in the slurry with a standard fungicide seed treatment. For treatment of turf apply when disease appears and repeat at 7-10 day intervals.

[ii] RATE — 9.29-17.88 kg a.i./ha in about 1500-2000 L water; 81.25-178.75 g a.i./100m^2 in 15-20 L water; 0.91-1.81 kg a.i./1000 m^2.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. GR

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 2-8 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Thermally stable up to the boiling point. Stable in water; common solvents. Store in a cool, dry place.[4] Stable < 268°C at ambient temperature in presence of alkali or acid.[4]

4. HANDLING PRECAUTIONS

Do not graze treated areas within 45 days. Do not use treated seed for food or feed.[2] Avoid contact with skin or clothing. Wash hands and face thoroughly with soap and water after use and before eating or smoking.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Subject to microbial decomposition in soil under moist conditions.[4] Chloroneb is metabolized to its corresponding p-quinone in soil.[4]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>11000 mg/kg		1
Rat	NOEL 2y F.T.	2500 mg/kg diet	Reduction in food consumption growth	1
Rabbit	LD_{50} dermal	>5000 mg/kg		1
Mallard	LD_{50} oral	>5000 mg/kg		1
Japanese quail	LD_{50} oral	>5000 mg/kg		1
Rainbow trout	LC_{50} 96h	3.7ppm		3
Bluegill sunfish	LC_{50} 46h	>4200 mg/L		1

[i] TOXICOTY (OTHER) – Not identified.

[ii] PHYTOTOXICITY — Considered non-phytotoxic when used at recommended dosages.[2]

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Chloroneb is metabolized to its corresponding p-quinone in plants.[4] It is a systematic fungicide which is taken up by roots, concentrated in the roots and lower stem portions, rendering them fungistatic.[4] Fungitoxicity is due to specific inhibition of DNA polymerization.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. AC
3. ECOTOX
4. HSDB

Chlorophacinone

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chlorophacinone (BSI, E-ISO, F-ISO, JMAF)

[ii] TRADE NAME — Rozol (Lipha Chemicals Inc.); Wilson's Mouse Treat (Wilson Laboratories Inc.); *Kemsan (Kensan Inc.).* Other names include Microzul, Ramucide, Topitox, Sanex, Caid, and Drat.

[iii] CHEMICAL NAME — 2-[2-(4-chlorophenyl)-2-phenylacetyl]indan-1,3-dione.

[iv] CAS # — 3691-35-8

[v] TYPE / MODE OF ACTION — Anticoagulant rodenticide. Disrupts prothrombin formation and oxidative phosphorylation.

2. USE PATTERN

For the control of mice, rats, moles, squirrels, muskrats, voles, gophers, and bats as well as skunks, ants, termites, fleas, and wasps. Chlorophacinone is effective in controlling warfarin-resistant rodents.

[i] APPLICATION — Apply where rodents have access. Use the tracking powder in areas where rodents travel. Replenish supply as it is consumed.[3]

[ii] RATES — 50.0-250 mg/kg bait (lethal dose to rodents is 0.005%) Often only one feeding is required. Apply 0.45 kg per 12 meters of runway area.

CARRIER: Mineral oil.

[iii] FORMULATIONS

1. PT
2. SN
3. DV
4. DU
5. SO
6. PE
7. Usually available in ready-to-use forms.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Non-corrosive, resistant to weathering. It is stable < 200°C, protect from extreme temperatures.[6]

4. HANDLING PRECAUTIONS

Wear protective mask and gloves when handling the concentrate. Whereever possible, toxic chemicals, concentrates and bait preparations should be handled in a fume cupboard. When bait mixing has been done in the field, operators should take care to remain sheltered from the wind. Care should be taken: not to contaminate foodstuffs; not to leave material within reach of children; to use prepared baits rather than scatter poison; to collect and destroy dead rodents; and to bury baits and powder when operation os completed. Smoking, eating and drinking must be strictly prohibited in all rooms in which poisons are present.[6]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Leaching behaviour is inversely related to clay and organic matter content of soils; low rate of leachability.[1] Immobile in soil and fairly insoluble in water.[7] Generally stable to hydrolysis; moderately persistent to persistent to aerobic soil degradation.[7]

[ii] AQUATIC – Potential for chlorophacinone to reach groundwater is low; they probably reach surface waters through adsorption to eroding soil, as opposed to dissolution in run-off.[7]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	20.5 mg/kg		2
Human	Single dose	20.0 mg a.i.	Uneventful recovery without treatment	1
Grey Partridge	15-day doses	2.25 mg a.i.	No ill effect	1
Rainbow trout	LC_{50} 96h	0.45 mg/L		5
Pheasant	LD_{50} oral	23.1 mg/kg		4
Partridge	LD_{50} oral	37.5 mg/kg		4
Pigeon	LD_{50} oral	21.8 mg/kg		4
Mallard	LD_{50} oral	11.8 mg/kg		4
Rook	LD_{50} oral	27.8 mg/kg		4

[i] TOXICITY (OTHER) — Low toxicity to birds.[3] Not hazardous to bees when used as directed.[1] Primary toxicity to mammals and birds is high, toxicity to aquatic organisms ranges from moderate to very high.[7]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In mammals, following oral administration, 90% is eliminated in the faeces within 48 hours in the form of metabolites.[1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Animals die a few days after dosing, avoiding bait shyness.[3]

6. REFERENCES

1. PM
2. FCH
3. AC
4. Kulczycki, A. (1985) Badania Wplywu Toksycznosci Fosforku Cynku I Chlorfacinonu na Wazniejsze Gospodarczo Ptaki Zerujace na Zasiewach. *Acta Agraria et Silvestria*, Vol. XXIV. P. 69-82.
5. ECOTOX
6. HSDB
7. USEPA. 1998. R.E.D. Facts: Chlorophacinone. Prevention, Pesticides and Toxic Substances. EPA-738-F-98-004, July.

Chloropicrin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — A trivial name is accepted in lieu of a common name: chloropicrin (BSI, E-ISO, ESA); chloropicrine (F-ISO)

[ii] TRADE NAME — Chloropicrin, Telone C17-R (Dow Agrosciences Canada Inc.); *Vorlex plus (Agr Evo Canada Inc.)*; Picfume

[iii] CHEMICAL NAME — trichloronitromethane

[iv] CAS # — 76-06-2

[v] TYPE / MODE OF ACTION — A tear gas used as a soil/commodity fumigant and rodenticide.

2. USE PATTERN

Soil fumigant for weeds, nematodes and certain fungal diseases (does not control fungi which form sclerotia). Timber fumigant. Used as a commodity fumigant on grains. Controls most plant parasitic nematodes, insects, rodents, weed seeds, and living plants. Used in fumigating buildings containing rodents (food/feed establishments, granaries, warehouses, and elevators), non-crop land, and outdoor living areas.

[i] APPLICATION — Use pre-plant only. Temperature of soil should be 15-29°C and soil surface should be moist at time of application. Discing before application will increase penetration. Apply 15-20 cm deep in soil 20-30 cm apart. Cover with a water seal or gas proof tarp or compact the soil. Expose for 24-48 hrs and aerate for 24 hours. Wait at least 2 weeks before planting. Commodities and buildings to be fumigated should be exposed to the gas for 24-36 hours. No limit to number of treatments. Seal all openings before treatment.

[ii] RATES — 0.5-1.4 kg actual/28.3 m^3, 0.5-2.7 kg actual/1000 bushels or 167-1196 mg actual/ha. Use the lower rate if tarped.

CARRIER: Not identified.

[iii] FORMULATIONS

1. LI
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 23.7 m
2. Air blast application: Calculated: (33.9) 24.5 m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Non-flammable; chemically rather inert. Emits vapours corrosive to aluminum and magnesium, zinc and other light metals, and iron. Non-corrosive to copper, brass, bronze. Formation of protective coating permits storage in iron or galvanized containers. Store in a cool, well ventilated place. Do not store in containers made of aluminum, magnesium, or alloys of these metals. Stable in acidic media, unstable in alkali.[1]

4. HANDLING PRECAUTIONS

Do not use to fumigate processed food or feed. Flush application equipment with fuel oil or kerosene, not water. Avoid fumigating in humid atmospheres. Do not treat near fields where leafy crops are growing. Handle outdoors when measuring out or transfering to other containers. When exposed to vapours wear full-face respiratory protection approved for acid gases and organic vapours. Avoid fumigating below 18°C, if grain moisture is high, or if soil is very dry or very wet. Compatible with other fumigants.[1]

5. ENVIRONMENTAL PERSISTENCE

Not used as structural fumigant since fumes do not dissipate quickly.

[i] SOIL – If applied to soil as would be the case in its use as a soil sterilant, chloropicrin will both rapidly volatilize and leach. It should photolyze on the soils surface. It may degrade in soil by chemical or biological processes. However degradation rates are unknown.[4]

[ii] AQUATIC – If released in water chloropicrin would readily volatilize (Half-life in a model river and model lake are 4.3 hr and 5.2 days respectively). It will photodegrade in the surface layers of water (Half-life ~3 days). Its rate of biodegradation in natural water is unknown, as is its rate of other abiotic dechlorination reactions. Chloropicrin would not be expected to adsorb to sediment or bioconcentrate in fish.[4]

[iii] ATMOSPHERIC – Extensively degraded to CO_2 by photolysis; DT_{50} in natural sunlight 4 days.[1]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	250 mg/kg		2
Cat	Exposure in air	0.8 mg/L air	Lethal in 20 min.	1
Guinea pig	Exposure in air	0.8 mg/L air	Lethal in 20 min.	1
Rabbit	Exposure in air	0.8 mg/L air	Lethal in 20 min.	1
Daphnia	*EC_{50} 3h*	*0.91 mg/L*		*1*

[i] TOXICITY (OTHER) — Lachrymatory and highly toxic. Can be lethal on exposure for 30-60 min. at 0.12 mg/L.[1] 1.42 g/28.3 m^3 lethal to mammals in 10 min.; 2.0 mg/L lethal if inhaled for 1 min.[3] Exposure to 0.1 µl/L for prolonged periods may cause injury.[3] Orally, exposure may cause severe nausea, vomiting, colic, and diarrhea.

[ii] PHYTOTOXICITY — Very toxic to many plants. Tomato plants unusually sensitive.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Often mixed with other fumigants to reduce fire hazard and as warning agent; tear gas property prevents personnel from remaining in concentration dangerous to human life. Rarely used alone. Costly; soil use usually limited to composts, greenhouse soils, cold frames, and small high crop-value field areas. Does not readily penetrate unrotted root knot nematode galls. Effectiveness increases in warmer soils. Only trained personnel should use.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HSDB

Chlorothalonil

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chlorothalonil(BSI, E-ISO, F-ISO, ANSI); TPN (JMAF)

[ii] TRADE NAME — Bravo, Daconil (ISK Biosciences Corp.); Tattoo C (Agr Evo Canada Inc.); Nopcocide; Rimidol Gold (Syngenta).

[iii] CHEMICAL NAME — tetrachloroisophthalonitrile

[iv] CAS # — 1897-45-6

[v] TYPE / MODE OF ACTION — Non-systemic foliar fungicide giving protective action.[1]

2. USE PATTERN

Broad spectrum fungicide used to control fungal diseases including leaf spot, early and late blight, downy mildew, and anthracnose on vegetable, tree fruit and other agricultural crops, turf, and ornamentals. Used against *Botrytis* spp. Soil-borne *Pythium* spp. not controlled.

[i] APPLICATION — Apply evenly and thoroughly; repeat at specified interval. Agitate while spraying. On turf, spray on set schedule. On potatoes, apply when plants are 15-20 cm high and continue at 7-10 day intervals. Do not use mistblowers or high pressure spray equipment when using in greenhouses.[4]

[ii] RATES — Vegetable crops, 0.6-2.4 kg a.i./ha. Sweet corn, 1.6 kg a.i./ha. Peach, nectarine, 2.5-4.5 kg a.i./ha. Ornamentals, 1.25 kg a.i./1000 L water. Conifers, 1.2-2.4 kg a.i./ha in 100-1000 L water. Spray volume 225-1600 L/ha diluted, 50-100 L/ha concentrated.[4]

CARRIER: Water.

[iii] FORMULATIONS

1. SU
2. DU
3. EC
4. WP
5. SO (DU for greenhouse use)

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 19-24 m (veg)/14-18 m (potato)
2. Air blast application:	Calculated: 19(29)-25(34) m (veg)/14(23)-19(28) m (potato)
3. Aerial application:	Label: 100 m
4. Forestry application:	Not identified.

3. STORAGE

Thermally stable under normal storage conditions. Stable to alkaline/acidic aqueous solutions and UV light. Non-corrosive. Do not store near feed or foodstuffs. Store in a cool place.[4]

4. HANDLING PRECAUTIONS

Do not mix with certain spray adjuvants. Do not graze livestock on treated areas. Do not apply directly to water. Not compatible with oils.[1] Avoid contact with skin or clothing, wash exposed areas of skin with soap and warm water after handling or using. Wear coveralls over long pants, and a long-sleeved shirt, goggles or a face shield, apron and chemical resistant gloves during mixing, loading, clean-up and repair activities. Wear pants, a long-sleeved shirt and chemical resistant gloves during application.[4] Do not take internally, do not breathe in spray mist. Do not re-enter treated areas within 48 hours of treatment.[4]

5. ENVIRONMENTAL PERSISTENCE

Relatively persistent with relatively long residual action.[1]

[i] SOIL — High adsorption to soil and low mobility in silty loam and clay loam soils (Half-life in aerobic soils is 1-3 months).[6] Degradation is faster in biotic aquatic systems, a wide variety of metabolites is formed, which are in turn degraded further.[1] Increased soil moisture or temperature increases chlorothalonil degradation. It is not degraded by sunlight on the soil surface.[6] Moderately persistent. High binding and low mobility in silty loam and silty clay loam soils, low binding and moderate mobility in sandy soil.[6]

[ii] AQUATIC — Biodegradation is a major fate process (Half-life ~0.18-8.8 days).[5] Hydrolysis may be important in alkaline waters. Aerobic aquatic metabolism half-lives from 2 hours to 8 days.[10] Limited potential to reach groundwater with concentrations being low. Can contaminate surface water via spray drift or through runoff and erosion, can be dissolved in runoff and adsorbed to sediment in runoff.[10]

[iii] ATMOSPHERIC - Not identified.

[iv] PHYTODEGRADATION — Does not translocate into plants from soil or topical application.[7] 4-hydroxy-2,5,6-trichloroisophthalonitrile is a major plant metabolite, but only negligible residues found in most crops.[1]

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	>10,000 mg/kg		6
Rat	NOEL	1.8 mg/kg b.w.		1
Mouse	LD$_{50}$ oral	6000 mg/kg		6
Rabbit	LD$_{50}$ dermal	>10,000 mg/kg		2
Dog	LD$_{50}$ oral	>5000 mg/kg		1
Human	ADI	0.03 mg/kg		1
Mallard	LD$_{50}$	>4640 mg/kg		1
Bobwhite quail	LC$_{50}$	5200 mg/kg		5
Rainbow trout	LC$_{50}$ 96h	0.076 mg/L	Technical grade	9
Rainbow trout	LC$_{50}$ 96h	0.0105mg/L		8
Bluegill sunfish	LC$_{50}$ 96h	62.0 ppb		1
Channel catfish	LC$_{50}$ 96h	0.052 mg/L	Static bioassay	5
Blue mussel	LC$_{50}$	5.9 mg/L	Bravo 500	9
Clam	LC$_{50}$ 96h	35 mg/L	Bravo 500	9
Daphnia	EC$_{50}$ 48h	70.0 ppb		1
Daphnia	LC$_{50}$ 48h	0.13-0.2 mg/L	Bravo 500	9

[i] TOXICITY (OTHER) — Single application of 100 mg to eyes of rabbits caused marked irritation and corneal opacities at 7 days. No effects on reproduction below maternally toxic levels.[7] Non-mutagenic and non-teratogenic.[6] Chronic administration has been associated with tumour formation in the kidney and forestomach of rats and male mice.[1] Allergic side effects in some people. No more than slightly toxic to bees, non-toxic to birds.[1] Toxic to fish, aquatic invertebrates, and marine organisms.[1]

[ii] PHYTOTOXICITY — Golden and yellow apple varieties have shown fruit russet. Slight russet of grapes has been noticed. Varieties of ornamentals have been injured. Phytotoxicity may be increased with oils or oil-containing substances.[1]

7. METABOLISM

[i] ANIMAL – Not well absorbed, rapidly excreted, primarily unchanged. Not stored in animal tisues. 4-hydroxy metabolite found in plants and animals is more toxic and more persistent than parent compound. In both ruminants and non-ruminants, chlorothalonil is not found in tissue or urine.[1]

[ii] PLANT – Majority of the residue remains as a parent compound.[1]

8. ADDITIONAL INFORMATION

Compatible with most other compounds. No advantage to adding sticker-spreader. Possesses eradicating properties on certain plant diseases.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. PP
7. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO Meeting on pesticide residues. II. Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews*, 66: 137-184.
8. Davies, P.E. and R. W. G. White. (1985) The Toxicology and Metabolism of Chlorothalonil in Fish. *Aquatic Toxicology* 7: 93-105.
9. Ernst, W., K. Doe, P. Jonah, J. Young, G. Julien, and P. Hennigar. (1991) The Toxicity of Chlorothalonil to Aquatic Fauna and the Impact of its Operational use on a Pond Ecosystem. *Archives of Environmental Contamination and Toxicology 21: 1-9.*
10. USEPA. 1999. R.E.D. Facts: Chlorothalonil. Prevention, Pesticides and Toxic Substances. EPA-738-F-99-008, April.

Chlorpyrifos

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chlorpyrifos (BSI, E-ISO, ANSI, ESA, BAN); chlorpyriphos (F-ISO, JMAF); chlorpyrifos-ethyl (France)

[ii] TRADE NAME — Lorsban, Dursban, Raid Roach and Earwig Terminals (Dow Chemical Co.)

[iii] CHEMICAL NAME — *O,O*-diethyl *O*-3,5,6-trichloro-2-pyridyl phosphorothioate

[iv] CAS # — 2921-88-2

[v] TYPE / MODE OF ACTION — Organophosphorous, non-systemic insecticide used as a contact and stomach poison with vapour action. Cholinesterase inhibitor.

[vi] NOTICE — In Canada, **the registration and sale of domestic class products was discontinued on December 31, 2001.** Commercial class chlorpyrifos products now require a label warning against use around residential areas. **As of December 31, 2000, use on tomatoes was discontinued**. Other **agricultural uses of chlorpyrifos are being re-evaluated**. A PMRA re-evaluation document dated March 18, 2003, proposes a discontinuation of chlorpyrifos use on certain crops (corn, filberts, lentils, oats, peppers, sugar beet, and tobacco) and that use on peaches and nectarines be allowed to continue until 2006. For the uses proposed for continued registration (canola, barley, carrot, flax, potato, wheat, strawberry, radish, Asian radish, celery, cucumber, cole crops, garlic, sunflower seeds, and rutabaga, and peaches and nectarines until 2006), it is proposed that environmental and occupational risks be mitigated. Mitigating measures may include a reduction of the number of applications per season, restriction in aerial applications, buffer zones to protect aquatic ecosystems, implementation of engineering controls and personal protective equipment for workers, and establishment of re-entry intervals for postapplication workers. In the United States, the EPA issued a cancellation order for chlorpyrifos containing, residential products on January 25, 2002. A phase out and elimination of other indoor and outdoor non-residential use chlorpyrifos products, to which children could be exposed, has also been initiated. In years following 2002, remaining uses including spot and local termiticide treatment will also be phased out. Tolerances for apple usage will be lowered and usage restricted to pre-bloom.

2. USE PATTERN

To control ectoparasites of cattle, sheep and poultry; as soil insecticide for vegetables, cereals and tobacco; as foliar insecticide for fruit, cereals, fodder crops, cotton, some vegetables, rice; control of mosquitoes (larvae and adults), roaches, earwigs, and flies. Volatile enough to form insecticidal deposits on nearby untreated surfaces.

[i] APPLICATION — Use as a spot treatment to control household pests and as wetting spray on lawns and ornamentals. Aerial equipment, mist applicators or hand/power sprayers used for mosquito control. On turf apply when temperature is above 27°C and repeat at 2 month intervals. Apply to soil as a pre-plant or post-emergence treatment. For foliar applications, apply when insects appear and repeat as necessary. May be applied through sprinkler irrigation systems.

[ii] RATES — Apply at 0.11-5.6 kg actual/ha. Mix with oil or water for mosquito control. 0.24-0.48% spray; 10.8-21.6 g a.i./100 m^2. 84.0-1920 g a.i./1000 L water; 1.8-3360 g a.i./ha. For structural pest control, multiple bait stations are required in buildings.

CARRIER: Synthetic clays, talc, and various solvents.

[iii] FORMULATION

1. SN
2. SO
3. PP
4. GR
5. DU
6. EC
7. WP

8. MS

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 40-46 m
2. Air blast application:	Calculated: 42(52)-49(59) m
3. Aerial application:	Calculated: >1000 m
4. Forestry application:	Not identified.

3. STORAGE

Stable under normal storage conditions. Keep out of reach of children. Extreme temperatures are unacceptable for storage. Corrosive to copper and brass. Incompatible with alkaline materials.[1]

4. HANDLING PRECAUTIONS

Do not use in poultry houses, animal buildings or where food is stored. Do not mix with alkaline compounds. To be applied only by professional personnel if used at concentrations above 0.5% active material. Ensure bait stations are inaccessable to children and pets.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Chlorpyrifos is persistent in soils and very resistant to leaching. Slowly degraded (Half-life ~60-120 days) to organochlorine compounds and carbon dioxide.[1] Degraded at a moderate rate, primary route of degradation is transformation to 3,5,6-trichloropyridin-2-ol, which is subsequently degraded to organochlorine compounds and CO_2.[1]

[ii] AQUATIC – The concentration and persistence of chlorpyrifos in water will vary depending on the type of formulation. Volatilization is probably the primary route of loss of chlorpyrifos from water.[8]

[iii] ATMOSPHERIC - Expected to exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase chlorpyrifos is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 4 hours. Particulate-phase chlorpyrifos will be removed from the atmosphere by wet and dry deposition.[9]

[iv] PHYTODEGRADATION — Little persistence in plants (Half-life on most plants 2-3 days, maximum 7-9 days). Virtually no uptake by plants after foliar or soil application. Generally, 99% of residue disappears after 10 days. The half-life in greenhouse tomatoes is 15-139 hrs, depending on the concentration of chlorpyrifos.[7]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	135-163 mg/kg		1
Rat	NOEL 2y	0.03 mg/kg/d	Based on plasma ChE activity	1
Guinea pig	LD_{50} oral	504 mg/kg		1
Rabbit	LD_{50} dermal	2000 mg/kg		2
Rabbit	LD_{50} oral	1000-2000 mg/kg		1
Dog	NOEL 2y	0.01 mg/kg/d	Based on plasma ChE activity	1
Human	ADI	0.01 mg/kg b.w.		1
Chicken	LD_{50} oral	32.0-102 mg/kg		1
Bobwhite quail	LC_{50} 8d	423 ppm		1
Mallard	LD_{50} oral	76.6 mg/kg		4
Pheasant	LD_{50} oral	17.7 mg/kg		4
Rainbow trout	LC_{50}	0.003 mg/L		1
Bluegill	LC_{50}	2.4 μg//L		4
Killifish	LC_{50}	3.2 mg/L		4
Oyster	LC_{50}	0.27 mg/L		4
Grass shrimp	LC_{50}	1.5 mg/L		4
Daphnia	*EC_{50} 48h*	*1.7 μg/L*		*1*

[i] TOXICITY (OTHER) — Chlorpyrifos is an active cholinesterase inhibitor, inhibiting plasma ChE to a far greater degree than other ChE's. Potentiation demonstrated only with malathion. No evidence of neurotoxicity, oncogenicity, mutagenicity or teratogenicity. Highly toxic to bees (LD_{50} oral 250 ng/bee).[1] Toxic to fish and crustacea, as well as birds and other wildlife. Toxic to aquatic invertebrates, estuarine and marine organisms.[8] It has shown no immediate marked effect on earthworms.[5] Non-teratogenic.[1] Non-mutagenic.[8]

[ii] PHYTOTOXICITY — Non-phytotoxic to most species of plants when used at recommended rates. Poinsettias are injured by this material, as are azaleas, comelias, roses, and variegated ivy.[3]

7. METABOLISM

[i] ANIMAL – Rapidly metabolized in animals. Residues found predominantly in the fat; excreted rapidly on cessation of treatment. In mammals, excretion of the primary metabolite 3,5,6-trichloro-2-pyrimidol is mainly in urine.[1]

[ii] PLANT – Non-systemic in plants, not absorbed from soil via the roots. Residues taken up by plant tissues are metabolized to 3,5,6-trichloropyridin-2-ol, which is conjugated and sequestered.[1]

8. ADDITIONAL INFORMATION

Very effective on soil, polluted water, wood and concrete. Contamination of natural water with this pesticide even at 0.005 mg/L may damage fisheries, due to a reduction in dissolved oxygen content, an increase in free CO_2, a reduction in zooplankton, and a decreased production of chironomid larvae.[6]

9. REFERENCES

1. PM
2. FCH
3. AC
4. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
5. Clements, R.O. and J.S. Bale (1988) The short term effects on birds and mammals of the use of chlorpyrifos to control leather jackets in grassland. *Ann. Appl. Biol.* Vol 112: 41-47.
6. Mani, V.G.T. and S.K. Konar (1988) Pollutional hazards of the pesticide chlorpyrifos on aquatic ecosystems. *Environ. Ecol.* Vol 6: 460-462.
7. Effects of Concentration and Application Method on Decay and Residual Activity of Foliar Chlorpyrifos. *J. Econ. Entomol.* 81: 621-627.
8. PP
9. HSDB

Chlorsulfuron

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chlorsulfuron(BSI, E-ISO, F-ISO, ANSI, WSSA)

[ii] TRADE NAME — Telar Herbicide Toss-n-Go Bags (Dupont Canada Inc.), Soccer (ICI Chipman), Glean (Dupont Canada Inc.)

[iii] CHEMICAL NAME — 2-chloro-*N*-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzene-sulfonamide

[iv] CAS # — 64902-72-3

[v] TYPE / MODE OF ACTION— Herbicide for control of weeds and algae. Foliar and root uptake.

2. USE PATTERN

For use in total vegetation control programs; for railroads, utility and highway rights of way, airports, plant sites, storage areas, petroleum tank farms, fencelines and utility substations, and for selective weed control in rough turf in Eastern Canada. Weeds controlled/supressed include lamb's-quarters, hemp nettle, wild mustard, volunteer rapeseed, flixweed, shepherd's purse, blue bur, scentless chamomile, chickweed, redroot pigweed, stinkweed, lady's thumb, wild carrot, sweet clover, annual sunflower, kochia, Russian pigweed, narrow leaved hawk's beard, plantain, prickly lettuce, bail mustard, Russian thistle, ragweed, green smartweed, cow cockle, stork's bill, corn spurry and common groundsel, common tansy, Canada thistle, dandelion, horsetail, wild rose, golden rod, perennial sow thistle, willow wild buckwheat and wild strawberry.

[i] APPLICATION — Apply when weeds are small (under 10 cm). A surfactant may be added to improve control of weeds growing under adverse conditions.

[ii] RATES — Apply 120 grams/ha of Telar herbicide tank mixed with Krovar I at 6.75-9.0 kg/ha. In Eastern Canada Telar herbicide may be applied to rough turf areas at 30,40, or 70 grams/ha mixed with either 2,4-D Amine 500 or 2,4-D Ester LV 700 at recommended concentrations.

CARRIER: Surfactant, water, other herbicides.

[iii] FORMULATIONS

1. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store product in original container, away from other pesticides, fertilizers, food, or feed. Render container unsuitable for further use when emptied. Keep out of reach of children and pets. Stable to light when dry. Decomposes at 192°C.[3] Non-corrosive, non-flammable, non-volatile and does not freeze.[5]

4. HANDLING PRECAUTIONS

Avoid breathing spray mist. Avoid contact with skin, eyes and clothing. Do not contaminate any body of water by storage or disposal. Do not sell water soluble bags separately. Do not apply or drain/flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the chemical may be washed or moved into contact with their roots. Do not use on lawns, walks, driveways, tennis courts, or similar areas. May be applied by ground equipment only.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Although chlorsulfuron is often employed at low rates, residual phytotoxicity can persist for up to 4 years. The degree of phytotoxicity may depend on the pH of the soil. A half-life of 85 days at pH 6.2 and 144 days at pH 8.1 at 20°C was determined in field studies. Dissipation of chlorsulfuron in soils occurs through chemical hydrolysis and by metabolic activity of soil microorganisms. There is potential for mobility in soil due to low soil adsorption. The potential for leaching would be greatest in soils of low organic content, coarse texture, and high pH. Other field studies have indicated that chlorsulfuron would have DT_{50} and DT90 values of 0.22 and 28 months respectively.[4]

[ii] AQUATIC – Bioconcentration of chlorsulfuron in aquatic organisms will be negligible.[6]

[iii] ATMOSPHERIC – If released to air, vapor phase chlorsulfuron may react with photochemically produced hydroxyl radicals with an estimated half-life of 5.1 hrs. Particulate absorbed chlorsulfuron may be removed from the atmosphere by dry deposition.[6]

[iv] PHYTODEGRADATION - Negligible under field conditions. Half-life is 1 month. In water under artificial light.[7]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LC$_{50}$ oral	2140 mg/kg		2
Rabbit	LC$_{50}$ dermal	3400 mg/kg		1
Mallard duck	LC$_{50}$ dietary 8d	>5000 mg/kg		3
Bobwhite quail	LC$_{50}$ dietary 8d	>5000 mg/kg		3
Trout	LOEC 24h	6.25 v/v		2
Rainbow trout	LC$_{50}$ 96h	>250 mg/L		3
Bluegill	LC$_{50}$ 24h	24.5 ppm		2
Bluegill	LC$_{50}$ 96h	>300 mg/L		3
Flounder	Acute toxicity	100 mg/L	48h	2
Minnow	Lethal	6.0 mg/L	6h	2
Shrimp	LC$_{50}$ 48h	80.0 mg/L	Aerated	2
Prawn	LC$_{50}$ 48h	42.5 ppm		2
Oysters	18 % lethal	100 mg/L	duration unspec.	2
Daphnia magna	*100% lethal*	*88.0 mg/L*	*64 hr*	*2*
Daphnia magna	*100% mortality*	*29.0 ppm*	*24-72 hrs*	*2*
Daphnia magna	*Lethal*	*0.1 mg/L*	*168 hr*	*2*

TOXICITY (OTHER) – Not identified.

PHYTOTOXICITY – Phytotoxic to many broad-leaved crops, particularly sugar beet and brassicas.[3]

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. FCH
2. Toxicity data from DOE
3. PM
4. Environment Canada, letter from Neil Tolson to Charles Smith, 1991.
5. PMRA
6. HSDB
7. HH

Chlorthal-dimethyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chlorthal-dimethyl (BSI, E-ISO, F-ISO); DCPA (WSSA); TCTP (JMAF)

[ii] TRADE NAME — Dacthal (AMVAC Chemical Corporation)

[iii] CHEMICAL NAME — dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate

[iv] CAS # — 1861-32-1

[v] TYPE / MODE OF ACTION— Phalic acid ester used as a selective pre-emergence herbicide.

2. USE PATTERN

For use on annual grasses and certain annual broadleaf species. It is not effective on rich organic and muck soils. Controls crabgrass and other annual grasses and some broadleaf weeds in lawns, onions, strawberries, some flowers and ornamentals, certain vegetable transplants and seeded vegetables and agromatic crops including cotton, soybeans and field beans.

[i] APPLICATION — Generally at planting time, pre-emergent to the weeds; applied with conventional sprayer to plants and soils.

[ii] RATES — 4.4-11.1 kg/ha depending on soil type and weed population. Apply 6.0-14.0 kg/ha for control of annual weeds in many crops. 13.75-16.25 kg a.i./ha.

CARRIER: Apply in spray rigs delivering 234-374 L of water/ha.

[iii] FORMULATION

1. WP
2. GR, flowable

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: <4 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Chlorthal-dimethyl is stable under normal storage conditions in both the pure state and in WP formulations. It is non-corrosive. Stable to heat and ultraviolet light.[1]

4. HANDLING PRECAUTIONS

Apply only to mineral soils. Do not graze treated areas or feed treated foliage or crop residue to livestock.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — The half-life in soil is 100 days. Degradation is due to hydrolysis and microbial degradation.[1] Essentially immobile in soil.[4] Duration of residual activity in soil is approximately 3 months.[1]

[ii] AQUATIC – Should bind strongly to particulate matter and sediment in the water column.[4]

[iii] ATMOSPHERIC – Will exist in the vapor and particulate phases in the atmosphere, and is is expected to degrade in the vapor phase by reaction with photochemically produced hydroxyl radicals with an estimated half-life of 36 days. Particulate phase chlorthal-dimethyl may be removed by wet and dry deposition.[4]

[iv] PHYTODEGRADATION — Not metabolized by plants.

[v] OTHER – Not identified.

6. TOXICITY

Animal	Test	Dose	Comments	Ref.
Rat	LD_{50} oral	>10000 mg/kg		2
Rat	NOEL 2y	1.0 mg/kg/d	No effects	1
Rabbit	LD_{50} dermal	10,000 mg/kg		2
Rainbow trout	LC_{50} 96h	>4.7mg/L		1
Mallard ducks	LC_{50} dietary 5d	>5620 ppm		1
Bobwhite quail	LD_{50}	>2250 mg/kg		1

[i] TOXICITY (OTHER) — Not toxic to fish at 500 µl/L. Bioaccumulates in aquatic organisms.[4] Single application of 3.0 mg to eyes of albino rabbits produced mild irritation which subsided within 24 hours. Slightly toxic to bees.[1]

[ii] PHYTOTOXICITY — Most turf grasses (with the possible exception of bents) have good tolerance.[3] Phytotoxic to beet, spinach, flax, and trefoil.[1]

7. METABOLISM

[i] ANIMAL - Metabolized in animals to monomethyl ester and to chlorthal, which are eliminated in urine.[1]

[ii] PLANT – Not metabolized by plants.[1]

8. ADDITIONAL INFORMATION

Absorbed by organic matter in soil; does not leach in any of the soil types. Not effective on mulch and peat soils at recommended rates. Lawns must not be reseeded for 60 days after treatment.

9. REFERENCES

1. PM
2. FCH
3. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control*: Atlantic Supplement Edition. 101 pp.
4. HSDB

Clofentezine

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — clofentezine (BSI, draft E-ISO, draft F-ISO, ANSI)

[ii] TRADE NAME — Apollo (Aventis CropScience Canada Co.); Panatac

[iii] CHEMICAL NAME — 3,6-bis(2-chlorophenyl)-1,2,4,5-tetrazine

[iv] CAS # — 74115-24-5

[v] TYPE / MODE OF ACTION— A diaryl tetrazine compound used as a contact acaricide.

2. USE PATTERN

Very effective against winter eggs of *Panonychus ulmi*, with no effect on predatory mites or beneficial insects.[1] Recommended for use on top fruit and experimentally being used on strawberries, vegetables, and ornamentals.[3] A specific acaricide, acting primarily as an ovicide with some effect against motile stages.

[i] APPLICATION — EUROPEAN RED MITE: Apply pre-blossom before winter eggs hatch, or early post-blossom before mite numbers exceed one/leaf. For repeat application, apply before numbers exceed three/leaf. TWO-SPOTTED SPIDER MITE and related species: Apply in the same fashion.

[ii] RATES — 20.0-50.0 g a.i./100 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. SC
3. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: <14-<20 m
2. Air blast application:	Calculated: <14(23)-<20(30) m
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Low flammability. Store in original container, tightly closed in a safe place.[4] Clofentezine and formulated products are stable to light, air, and heat.[1]

4. HANDLING PRECAUTIONS

Aviod contact with eyes, skin, and clothing. Wash hands and exposed skin before eating, drinking, or smoking, and after spraying or handling. Wash all contaminated clothing before reuse.[4]

5. ENVIRONMENTAL PERSISTENCE

Excellent residual control.

[i] SOIL — It's low solubility in water allows very little leaching of Clofentezine from soils.[3] It is rapidly degraded in soil, ultimately to CO_2 but with the formation of some soil-bound residues.[3]

[ii] AQUATIC — Rapidly degraded in water and sediments[3] at 22°C; the half-life is about 250 hours at pH5, 35 hours at pH7, and 4 hours at pH 9.[2]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION — An examination of treated apples indicated that residues in the fruit due to uptake from soil are extremely low. Residues remained in the pommace (animal feed) but no taint was observed in cider or canned juice or sauce made from these apples.[3] A single early season spray at a rate of up to 0.6% a.i. gives residues on apples and pears (at harvest) at or below the determination level of 0.01 mg/kg. The half-life on strawberries is 5 days, and residues at harvest are 0.01-0.15 mg/kg.[1]

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5200 mg/kg		1
Rat	LD_{50} dermal	>1332 mg/kg		1
Human	ADI	0.02 mg/kg b.w.		3
Rainbow trout	LC_{50} 96h	0.015mg/L		1
Daphnia	*EC_{50} 48h*	*>1.45mg/l*		*1*
Mallard	LD_{50} oral	>2100 mg/kg		1
Bobwhite quail	LD_{50} oral	>7500 mg/kg		1

[i] TOXICITY (OTHER) — Safe to bees, beneficial arthropods and predatory mites. Slight injury to roses grown under glass.[2]

[ii] PHYTOTOXICITY – May cause slight injury to glasshouse roses. May cause a slight pink deposit on petals of white or pale flowers.[1]

7. METABOLISM

[i] ANIMAL — Undergoes metabolism by hydroxylation and exchange of the chlorine atoms on the rings for methyithio groups.[1] Residues are unlikely to occur in milk or meat from animals consuming pommace as a part of their diet. Fecal excretion is the predominant route of elimination.[3]

[ii] PLANT — Unchanged clofentezine is the major residue, with trace levels of photodegradation products on the plant surfaces.[3]

8. ADDITIONAL INFORMATION

The solubility of clofentezine in water is 2.5 µg/L water at 25°C.[1]

9. REFERENCES

1. PM
2. AC
3. Pesticide Residues in food-1986. Part I. Residues. FAO Plant Prod. Prot. Pap., 78: 47-68 (1986).
4. FCH

Copper sulphate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The trivial name copper sulphate is used in lieu of a common name.

[ii] TRADE NAME — Clean Crop Copper 53W (United Agri Products)

[iii] CHEMICAL NAME — Copper sulphate (composed of cupric sulphate pentahydrate)

[iv] CAS # - 7758-98-7

[v] TYPE / MODE OF ACTION — Inorganic copper compound used as a preventative foliar fungicide and algicide.

2. USE PATTERN

Used to control bacterial and fungal diseases such as mildews and blights in fruit, vegetable, and field crops. Also used in wood preservatives and anti-fouling paints for ships. Controls algae in lakes and ponds, roots in tile drains and sewer pipes, and algae in swimming pools.

[i] APPLICATION — Mixed with lime when used on crop plants. Copper sulphate, unmixed, is used for algae control and as a wood preservative. May be used as a spray, covering entire area from a boat or plane, or injected into the water. May be placed in a cloth bag and towed through the area. Apply over water surface above weeds in early summer and repeat if necessary in late summer.[2] May also be used as a seed treatment.

[ii] RATES — Vegetable crops, 1.72-3.31 kg a.i./ha. Apple, pear, 0.53 kg a.i./1000 L water. Ornamentals, 6.88-13.75 mL a.i./100 L water. Algae control, 4.88-6.75 kg a.i./ha in water bodies with 1 m depth.[4]

CARRIER: Water or no carrier.

[iii] FORMULATIONS

1. SN
2. SP
3. SG
4. WP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 4-9 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Corrosive to metals. Copper sulphate is liable to oxidation to cupric oxide and conversion to a carbonate on exposure to moist air and is apt to corrode aluminum. Not compatible with highly alkaline pesticides, or with fenvalerate, parathion, chlorpyrifos or dicloran.[1]

4. HANDLING PRECAUTIONS

Do not use on crop plants unless mixed with lime. Incompatible with soap. Do not use in areas where fumigation with HCN gas occurs. Caustic. Avoid contact, wear protective equipment, frequent clothing change.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – As a naturally occurring substance, copper persists indefinitely.[7] It is very reactive and tends to adsorb easily to clays and humic materials.[7] Aqueous t 1/2 of 1-7 d.[9] Does not undergo microbial breakdown or photodegradation.[3]

[ii] AQUATIC – Will bind to particulates and sediment in water. No evidence of biotransformation in aquatic environments.[5]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	472 mg/kg	Copper	7
Rabbit	LD_{50} dermal	8000 mg/kg		6
Chicken	LD_{50} oral	300-500 mg/kg	Powder	6
Rainbow trout	LC_{50} 96h	0.19-0.21 mg/L	Flow-through, Hardness 125 mg/L	6
Bluegill	LC_{50} 96h	0.4-1.02 mg/L	Hardness 52-365 mg/L	6
Atlantic salmon	LC_{50} 96h	0.048 mg/L	Hardness 20 mg/L	6
Chinook salmon	LC_{50} 96h	0.032 mg/L	Hardness 21 mg/L	6
Common carp	LC_{50} 96h	0.063 mg/L	Hardness 19 mg/L	6
Fathead minnow	LC_{50} 96h	0.46-0.49 mg/L	Hardness 202 mg/L	6
American eel	LC_{50} 96h	2.54 mg/L	Hardness 40-48 mg/L	6
Crayfish	EC_{50} 48h	3.0 mg/L	Hardness 100-125 mg/L	6
Daphnia	*EC_{50} 48h*	*0.2 mg/L*	*Hardness 226 mg/L*	*6*

[i] TOXICITY (OTHER) — Toxic to fish and aquatic invertebrates.[8] May be corrosive to eyes, mucous membranes, skin, gastrointestinal tract. Swallowing may cause nausea, shock. Acute oral LD_{50} is difficult to determine as oral intake leads to nausea.[1] Toxic to bees, less toxic to birds than to others animals.[1]

[ii] PHYTOTOXICITY — It is the soluble copper form that is phytotoxic and bio-available to most aquatic organisms. Complexes and adsorbed copper largely non-toxic. Phytotoxic to most plants when not mixed with lime to form Bordeaux mixture. Wheat is also injured. It burns the foliage of plants.[2]

7. METABOLISM

[i] ANIMAL – Copper is an essential element and is under homeostatic control in mammals.[1] Residual copper is an essential trace element that is strongly bioaccumulated and stored primarily in the liver, brain, heart, kidney and muscles.[7]

[ii] PLANT - There is no build up of copper in plants.[8]

8. ADDITIONAL INFORMATION

May be applied at any time during the growing season. Mainly used in preparation of Bordeaux mixture.

9. REFERENCES

1. PM
2. AC
3. HH
4. PMRA
5. HSDB
6. CESARS
7. PP
8. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation. 1988. 827 pp.
9. Reinert, K.H. and Jill Rodgers (1987) Fate of aquatic herbicides. *Reviews of Environmental Contamination and Toxicology*, Vol. 98: 61-98.

Coumaphos

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — coumaphos (BSI, E-ISO, F-ISO, ESA, BAN); exception (FRG)

[ii] TRADE NAME — Co-Ral, Spray Stuff, K.R.S. Spray Foam (Bayer Inc.)

[iii] CHEMICAL NAME — *O*-3-chloro-4-methyl-2-oxo-2*H*-chromen-7-yl *O,O*-diethyl phosphorothioate

[iv] CAS # — 56-72-4

[v] TYPE / MODE OF ACTION — Livestock insecticide. An organophosphorous material (phosphorothioate). Currently of little commercial interest.

[vi] NOTICE — **The PMRA re-evaluation decision, March 31, 2003, proposed acceptability for continuing registration**, as the use of coumaphos and associated end-use products on cattle, swine and horses does not entail unacceptable risk of harm to human health or the environment. It is proposed that the Food and Drugs Regulations (FDR) be amended so that, with the exception of meat, meat by-products and fat of cattle and swine, food with residues of coumaphos cannot be sold in Canada, unless additional data to support coumaphos residues in imported food are provided.

2. USE PATTERN

For use on beef cattle, dairy cattle, horses and swine. Used for the control of insect, horn fly, fly maggots, and lice. Acts as both a contact and systematic insecticide.

[i] APPLICATION — CATTLE: Apply not more than 0.55 a.i./head. Dust evenly into the hair over the head, neck, shoulders, back and tailhead for control of horn flies and lice. SWINE: Apply not more than 0.28 g a.i./head as a uniform coat to the shoulders and back. Only 2 treatments 10 days apart should be applied per season. TREATMENT: (spray foam, 3%) For the treatment of wounds infested with fly maggots on beef cattle and horses, spray wounds until complete coverage is obtained. Repeat as necessary, but not more often than weekly. Use as prevention on a new wound from dehorning, castration, docking, injury, etc. as soon as possible to avoid infestation. Repeat as necessary, but not more often than weekly.

[ii] RATES— Not identified.

CARRIER: Insoluble in water. Soluble in aromatic solvents, less so in alcohols and ketones.

[iii] FORMULATIONS

1. DU
2. PP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Not identified.
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Hydrolyzes slowly under alkaline conditions.

4. HANDLING PRECAUTIONS

Do not spray animals in confined area or apply to animals that are stressed, sick, or less than 3 months old. Do not use with other insecticides or internal medicines. Do not use before or after natural or synthetic pyrethrins or their synergists. Incompatible with piperonyl butoxide. Do not apply directly to any body of water.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Low to moderate persistence in soil. Relatively immobile in a sandy loam soil and is unlikely to contaminate groundwater. Binds well to soil particles and therefore does not readily leach with water percolation.[2]

[ii] AQUATIC – Resistant to bhydrolysis, stable over a wide pH range.[2]

[iii] ATMOSPHERIC – Vapor-phase coumaphos will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals and ozone; half-lives for these reactions in air are estimated to be 3.7 and 14 hours, respectively. Particulate-phase coumaphos will be physically removed from the atmosphere by wet and dry deposition.[4]

[iv] PHYTODEGRADATION – Coumaphos absorbs light in the environmental spectrum suggesting a potential for direct photolysis.[4]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50}	15.5 mg/kg	Females	1
Pheasant	LC_{50}	300-400 mg/kg		
Coturnix	LC_{50}	200-250 mg/kg		
Musca autumnalis	LD_{50}	1.170 µg/mg b.w.		
Musca autumnalis	LD_{90}	2.264 µg/mg b.w.		
Horn flies	LD_{50}	0.184 ng/fly	Female	
Horn flies	LD_{90}	0.382 ng/fly	Female	
Stable flies	LD_{50}	0.769 ng/fly	Female	
Stable flies	LD_{90}	1.072 ng/fly	Female	
Harlequin fish	LC_{50} 24h	0.082 mg/L		
Daphnia magna	LC_{50} 48h	0.001 mg/L		1
Gammarus lacustris	LC_{50} 48h	0.00014 mg/L		
Gammarus lacustris	*LC_{50} 24h*	*0.00032 mg/L*		

[i] TOXICITY (OTHER) — Cattle on fattening ration may be more susceptible to organic phosphate poisoning than animals on pasture or maintenance feed. Generally not applied to plants. Highly toxic to birds, moderately toxic to fish, highly toxic to aquatic invertebrates, moderately toxic to honeybees and other beneficial insects.[2] Highly toxic by ingestion and moderately toxic by inhalation and dermal absorption,may cause mild irritation.[2] Non-teratogenic, non-mutagenic.[2] Non-carcinogenic in humans.[3]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Following oral administration to mammals, coumaphos is rapidly broken down into non-toxic products that are eliminated in urine and faeces with no evidence of bioaccumulation.[2]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Meldane is registered as a 2% Feed Premix. Baymix is registered as a 2% and 11.2% Feed Premix and 0.32%. Crumbles for use as an anthelminthic in cattle.

9. REFERENCES

1. PM
2. PP
3. USEPA. 1996. R.E.D. Facts: Coumaphos. Prevention, Pesticides and Toxic Substances. EPA-738-F-96-014, August.
4. HSDB

Cupric hydroxide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — cupric hydroxide, copper hydroxide

[ii] TRADE NAME — Champion (Nufarm Americas Inc.); Kocide, Spin Out (Griffin); Tex-R (Texel Inc.)

[iii] CHEMICAL NAME — copper (II) hydroxide

[iv] CAS # — 20427-59-2

[v] TYPE / MODE OF ACTION — Inorganic fungicide and bactericide with protective action.[1]

2. USE PATTERN

Used for control of bacterial blight, leaf spot, early and late blight, and bacterial spot on vine, vegetable, and cereal crops. Also used as a plant growth regulator in pine, spruce, and fir.[2]

[i] APPLICATION — Apply when disease threatens in peppers, tomatoes, and sugar beets. Can be combined with mancozeb for the control of early and late blight in potato when plants are 15 cm high. Do not apply within one day of harvest. One application is sufficient to control root spiraling in nursery tree crops. Used in landscape fabrics to control weeds on industrial sites.[2]

[ii] RATES — Field crops, 1.13-2.25 kg a.i./ha. Potatoes, 0.55-1.13 kg a.i./ha. Landscape fabric contains 6 g a.i./ square meter.[2]

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. SG
3. SN
4. IF

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 10-17 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stability depends on the method of formulation. May decompose to black oxide on standing a few days.[3] Avoid contact with skin and eyes.

4. HANDLING PRECAUTIONS

No additional surfactants are needed. Applying to grapes under cool, slow drying conditions is likely to cause injury.[2]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Copper is likely to be more mobile under acidic rather than alkaline conditions.[3]

[ii] AQUATIC — Some copper complexes may be biotransformed, but there is little evidence that this is a major fate process. [3]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1000 mg/kg		1
Rabbit	LD_{50} dermal	>3160 mg/kg		1
Bobwhite quail	LD_{50} oral	3400 mg/kg		1
Mallard	LD_{50} oral	>5000 mg/kg		1
Rainbow trout	LC_{50} 24h	0.08 mg/L		1
Bluegill sunfish	LC_{50} 96h	>180 mg/L		1

[i] TOXICITY (OTHER) — Not toxic to bees.

[ii] PHYTOTOXOCITY – Not identified.

7. METABOLISM

[i] ANIMAL - Copper is incorporated into over twelve specific copper proteins including cytochrome oxidase. Copper readily crosses the placenta and is stored in the fetal liver.[4]

[ii] PLANT – Plants resist copper accumulation and translocation to stems, leaves or seeds.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. PMRA
3. HSDB
4. Booth, N.H. and L.E. McDonald (eds.). 1982. Veterinary Pharmacology and Therapeutics. 5th ed. Iowa State University Press, Ames, Iowa.

Cyanazine

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — cyanazine (BSI, E-ISO, F-ISO, WSSA)

[ii] TRADE NAME — Bladex (Dupont Canada Inc.); *Blazine (Dupont Canada Inc., Ciba Geigy Canada Ltd.).*

[iii] CHEMICAL NAME — 2-(4-chloro-6-ethylamino-1,3,5-triazin-2-ylamino)-2-methylpropionitrile

[iv] CAS # — 21725-46-2

[v] TYPE / MODE OF ACTION— Pre- and post-emergence triazine herbicide of short persistence. Absorbed by roots and foliage. Inhibits photosynthesis.

[vi] NOTICE — **The active cyanazine is being discontinued with December, 2004 being the last date of sale.**

2. USE PATTERN

General weed control: Applied pre-emergence to maize, peas, and broad beans, or post-emergence in combination with hormone weedkillers for control of hard-to-kill broadleaf weeds in wheat and barley.[1] Excellent control of crabgrass. Severe infestations of barnyard grass, fall panicum, or pigweed may not be adequately controlled by pre-plant applications alone under conditions that delay weed germination.[4]

[i] APPLICATION — Sprayed pre-emergence to corn for best results. Avoid incorporating into dry soil. Used post-emergence up to the three leaf stage. Do not use flowable formulations post-emergence to the crop. Constant agitation required. For treatment of fallow land apply in the fall (after harvest) when rain is expected within 10 days. Application may also be made to land in early spring.[3] Tank mixed with other herbicides such as atrazine and butylate.

[ii] RATE — CORN: Pre-plant, 1.8-2.7 kg a.i./ha. Pre-emergence, 1.58-2.7 kg a.i./ha. Post-emergence, 1.8-2.25 kg a.i./ha.[5]

CARRIER: Water and liquid fertilizers for pre-emergence; no liquid fertilizers for post-emergence.

[iii] FORMULATIONS

1. SU
2. WP
3. WG
4. SG

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 0 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

The shelf life of formulated Bladex® is greater than 1 year. Non-corrosive and compatible with most commercial pesticides and fertilizer solutions. Stable to heat, light, and to hydrolysis in neutral or slightly acidic or basic media.

4. HANDLING PRECAUTIONS

Keep dry. Do not apply post-emergence when mixed with liquid fertilizer. Not recommended for heavy clay or muck soils.[9] For maximum activity rainfall is required within 10 days after pre-emergence application.[9]

5. ENVIRONMENTAL PERSISTENCE

Moderate residual activity; no carry-over hazard.[9] Provides control for at least 10-12 weeks.[3]

[i] SOIL — Reversibly adsorbed. Leaching rate in sandy loam is comparable to atrazine (11.5 cm with 5 cm of applied water).[4] Under field conditions, minimal loss by photodecomposition or volatilization.[4] Primarily degraded in soil by microbial action.[4]

[ii] AQUATIC — Degradation mainly by microbial action and catalyzed hydrolysis.[6]

[iii] ATMOSPHERIC – Not identified

[iv] PHYTODEGRADATION – Cyanazine will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase cyanazine is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 41 hours. Particulate-phase cyanazine may be removed from the air by wet and dry deposition.[6]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	182-334 mg/kg		1
Rat	LD_{50} dermal	>1200 mg/kg		8
Mouse	LD_{50} oral	380 mg/kg		1
Rabbit	LD_{50} oral	141 mg/kg		1
Rabbit	LD_{50} dermal	>2000 mg/kg	Technical grade	8
Dog	NOEL 2 y F.T.	25.0 mg/kg diet		1
Mallard	LD_{50} oral	>2000 mg/kg		1
Bobwhite quail	LD_{50} oral	400 mg/kg		8
Rainbow trout	LC_{50} 24h	12.0 mg/L		7
Rainbow trout	LC_{50} 96h	9.0 mg/L		7
Bluegill	LC_{50} 96h	22.5 mg/L	Bladex WP 80%	6
Channel catfish	LC_{50} 96h	10.4-17.4 mg/L		7
Harlequin fish	LC_{50} 24h	16.0 mg/L		2
Harlequin fish	LC_{50} 48h	10.0 mg/L		7
Harlequin fish	LC_{50} 96h	7.5 mg/L		8
Fathead minnow	LC_{50} 96h	16.3 mg/L		6
Sheepshead minnow	LC_{50} 96h	18.0 mg/L		8
Gammarus fasciatus	LC_{50} 96h	2.0 mg/L	Technical grade	6
Daphnia	*EC_{50} 48h*	*42.0-106 mg/L*		*1*

[i] TOXICITY (OTHER) — Low toxicity to fish and wildlife.[4] Not toxic to bees (LD_{50} oral >0.19 mg/bee).[1] Non-mutagenic, non-carcinogenic.[8]

[ii] PHYTOTOXICITY – Selective if applied according to label recommendations.[1]

7. METABOLISM

[i] ANIMAL – Metabolism and excretion rapid in mammals. In rats and dogs, cyanazine is metabolized and eliminated within 4 days following oral administration.[1]

[ii] PLANT - In plants, the nitrile group is hydrolysed to a carboxylic acid group, and the chlorine atom is replaced by a hydroxyl group.[1]

8. ADDITIONAL INFORMATION

Readily absorbed by leaves. Absorption by roots and translocation to leaves. Not to be used on peat or muck soils, or on sandy soils which contain less than 1% organic matter. Short-lived so there should be no carry-over problems on fall seeded crops.[1] Use heavier rates for heavy soils. Solubility in water is 171 mg/L.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. PMRA
6. HSDB
7. CESARS
8. PP
9. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control*. 101 pp.

Cycloate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — cycloate (BSI, E-ISO, F-ISO, WSSA); hexylthiocarbam (JMAF)

[ii] TRADE NAME — Ro Neet (Cedar Chemical Co.)

[iii] CHEMICAL NAME — *S*-ethyl cyclohexyl(ethyl)thiocarbamate

[iv] CAS # — 1134-23-2

[v] TYPE / MODE OF ACTION— Thiocarbamate compound effective as a selective soil incorporated herbicide.

[vi] NOTICE — **Only the technical is registered in Canada. The active cycloate is under re-evaluation.**

2. USE PATTERN

Pre-plant selective herbicide: Use on sugar beet, spinach, and beet to control annual grasses, nutgrass, certain perennial grasses and many broadleaf weeds.[1]

[i] APPLICATION — Apply to a well prepared seed bed, using boom and ground spray equipment, impregnated on dry bulk fertilizers, or mixed with fluid fertilizer. Incorporate immediately into the soil to a depth of 5-7.5 cm. Plant immediately. If applied to extremely dry soil during dry climatic conditions, incorporation may be accomplished by overhead irrigation following application. Apply only to soil dry enough to ensure thorough mixing.[3]

[ii] RATES — Applied at 3.0-45.6 kg a.i./ha in 200-1123 L water.

CARRIER: Emulsifiable liquid formulations are diluted in water and applied at a volume of 222-1123 L/ha.

[iii] FORMULATIONS

1. EC
2. GR
3. LI

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Apparently indefinite storage life under normal conditions (ambient). Photosensitivity is indeterminate. Non-corrosive. No incompatibilities known or expected.

4. HANDLING PRECAUTIONS

A volatile material so incorporation must be done immediately after application.[3] Do not band apply on rocky soils since thorough incorporation is impossible.[3] Do not use a drag behind the planter as it may concentrate the chemical over the seed row. Use on mineral soils only.[3] Do not combine with other pesticides. Do not apply before a pre-irrigation.[3]

5. ENVIRONMENTAL PERSISTENCE

Non-persistent.

[i] SOIL — Under crop growing conditions, cycloate had a half life of 4-8 weeks in several soils. Quite resistant to leaching in heavy clay and high organic soils. In loamy sand, leached downwards 7.5-15 cm with 20 cm of water (leached less than EPTC or pebulate).[4] Microbial breakdown is responsible for a large part of the disappearance of cycloate from soils when incorporated in the soil to a depth of 5-7.5 cm.[4] Lost from moist soils by vaporization when applied to surface without incorporation. Very little loss occurs after application to dry soil surfaces.[4]

[ii] AQUATIC – Will volatilize slowly from water.[5]

[iii] ATMOSPHERIC - Cycloate will exist primarily in the vapor phase in the ambient atmosphere. In the vapor phase, it will degrade in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of 10 hrs.[5]

[iv] PHYTODEGRADATION — Rapidly taken up by roots and translocated. Rapidly metabolized in roots and leaves of sugarbeet to ethyl-cyclohexylamine, CO_2, amino acids, sugars, and other natural plant constituents. No unchanged cycloate could be detected 3 days after treatment.[4]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	3160-4100 mg/kg	Females	1
Rat	LD_{50} oral	2000-3190 mg/kg	Males	1
Rat	NOEL 90d	55.0 mg/kg/d	No ill-effects	1
Dog	NOEL 90d	240 mg/kg/d	No ill-effects	1
Albino rabbit	LD_{50} dermal	4640 mg/kg	Ro-Neet 6E	4
Bobwhite quail	LC_{50} dietary 7d	>56,000 mg/kg	Ro-Neet 6E	4
Rainbow trout	LC_{50} 96h	4.5-5.6 mg/L		2
Rainbow trout	LC_{50} 96h	4.5 mg/L	Technical Ro-Neet	4
Mosquito fish	LC_{50} 96h	10.0 mg/L	Ro-Neet 6E	4

[i] TOXICITY (OTHER) – Not toxic to bees at 0.011 mg/bee.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Cycloate is converted to the sulfoxide by microsomal enzymes, and then cleaved rapidly by the liver soluble-glutathione system.[1]

[ii] PLANT – Rapidly metabolized in the roots and leaves of beets. Metabolites include ethyl cyclohexylamine, CO_2, amino acids, sugars, and other natural plant constituents.[1]

8. ADDITIONAL INFORMATION

Existing nutgrass can be controlled by turning under and chopping up weeds thoroughly before application. Cycloate is an analogue of EPTC. Six to twelve weeks control may be expected.[3]

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. HSDB

Cyhalothrin-lambda

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — lambda-cyhalothrin (BSI, draft E-ISO); lambda-cyhalothrine (draft F-ISO); cyhalothrin-lambda.

[ii] TRADE NAME — Matador, Karate (Syngenta Crop Protection Canada Inc.)

[iii] CHEMICAL NAME — (*RS*)-a-cyano-3-phenoxybenzyl-(1*RS*)-*cis*-3-(*z*-2-chloro-3,3,3-trifluorprop-1-enyl) 2,2,-dimethyl-cyclopropanecarboxylate.

[iv] CAS # — 91465-08-6

[v] TYPE / MODE OF ACTION — Non-systemic synthetic pyrethroid insecticide with contact and stomach action. Has repellent properties and gives rapid knockdown and long residual action.[1]

2. USE PATTERN

Used for control of foliar pests such as aphids, leafminers, Colorado potato beetle, thrips, and grasshoppers on oilseeds, cereals, pastures, and tree fruit crops.[2]

[i] APPLICATION— Best applied at early stages of pest development. Apply by ground sprayer only. Use 100-200 L water/ha for thorough coverage. Control may decrease as temperatures rise. Avoid applying in the heat of the day.[2]

[ii] RATES — Cereal crops, 7.56-9.96 g a.i./ha. Potato, 5.04-9.96 g a.i./ha. Fruit crops, 9.96-12.48 g a.i./ha.[2]

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 26 m
2. Air blast application:	Label: 80 m
3. Aerial application:	Calculated: >1000 m
4. Forestry application:	Not identified.

3. STORAGE

Store above 0°C. If temperatures fall below 0°C, agitate well before using product. Stable to light.[1]

4. HANDLING PRECAUTIONS

Allow a 7 day interval between treatments on vegetable and cereal crops.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Rapidly degraded in soil. Strongly adsorbed to soil and sediment organic matter. Leaching in a range of soils is negligible. Half-life ~4-12 weeks.[1]

[ii] AQUATIC – Rapid dissipation from water in aquatic systems.[1]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	79.0 mg/kg	Male rats	1
Rat	LD_{50} oral	56.0 mg/kg	Female rats	1
Rat	LD_{50} dermal	1292-1507 mg/kg		1
Dog	NOEL 1y	0.5 mg/kg/d		1
Mallard	LD_{50} oral	>3950 mg/kg		1
Quail	LC_{50} dietary	>5000 mg/kg		1
Rainbow trout	LC_{50}	0.24 µg/L		1
Bluegill sunfish	LC_{50}	0.21 µg/L		1
Daphnia	*EC_{50} 48h*	*0.36 µg/L*		*1*

[i] TOXICITY (OTHER) — Toxic to fish. Toxic to bees (LD_{50} oral 38.0 ng/bee).[1] Non-mutagenic in the Ames test.[1] Mild eye irritant; non-irritant to skin. Not a skin sensitizer.[1] Toxic to some non-target arthropods.[1]

[ii] PHYTOTOXICITY - Not identified.

7. METABOLISM

[i] ANIMAL - In rats, following hydrolysis of the ester group, cyhalothrin-lambda is rapidly excreted in the urine and faeces.[1]

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

Localized populations of insect pests such as Colorado potato beetle may develop resistance.[2]

9. REFERENCES

1. PM
2. PMRA

Cypermethrin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — cypermethrin (BSI, E-ISO, ANSI, BAN); cypermethrine (F-ISO)

[ii] TRADE NAME — Ripcord (BASF Canada); Cymbush (Zeneca Agro); Eliminator Ear Tag (Novartis); *Stockaid Ear Tag (Ciba Geigy Ltd.).* Other names include Venture and Green Cross Vapona.

[iii] CHEMICAL NAME — (*RS*)-a-cyano-3-phenoxybenzyl (1*RS*,3*RS*; 1*RS*,3*SR*)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate.

[iv] CAS # — 52315-07-8

[v] TYPE / MODE OF ACTION— A synthetic pyrethroid insecticide with contact, stomach, anti-feeding action,[1] and fast knockdown activity.[3] Technical cypermethrin is a mixture of eight isomers, each of which may have its own chemical and biological properties.[6]

2. USE PATTERN

For use against Lepidoptera, Coleoptera, Diptera, Hemiptera, Homoptera, and others. Used on fruit, field, and vegetable crops. Also used as an animal ectoparasiticide.[1] Used in public health programs for control of insect pests in apartment buildings, stores, and warehouses.[6]

[i] APPLICATION — Apply when insects first appear and repeat as necessary. Good coverage is necessary, since it has no systemic or fumigant activity. Used on livestock as a spray or in impregnated ear tags.[3] Control of the pea pod borer is greatest when 3 applications are made from 35 to 49 days after planting, but the pea pod bug is controlled better when the 3 applications are more spread out (*i.e.*, 35-56 days after planting).[9]

[ii] RATES — Vegetable crops, 25.0-50.0 g a.i./ha. Wheat, barley, 20.0-28.0 g a.i./ha. Corn, 70.0 g a.i./ha. Apple, pear, 70.0 g a.i./ha. Ear tags, 1-2 ear tags/animal (0.84 g a.i./tag).[4]

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. IF
3. SR
4. WP

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 23-34 m
2.	Air blast application:	Calculated: 36(46)-39(49) m
3.	Aerial application:	Calculated: 240- >1000 m
4.	Forestry application:	Not identified.

3. STORAGE

Store in original container. Keep tightly closed and in a safe place.

4. HANDLING PRECAUTIONS

Harmful or fatal if swallowed or absorbed through skin. Avoid contact with skin, eyes and clothing. Wear long-sleeved shirt or coveralls and gloves when handling or spraying. With proper protective clothing, absorption of cypermethrin by workers is minimal because the amount of chemical that is absorbed is only a very small proportion of that contacting the skin.[8] Do not apply at temperatures above 27°C. This product is very toxic to bees so avoid spraying when bees are foraging. Control is better at lower temperatures.[4]

5. ENVIRONMENTAL PERSISTENCE

Photodegradation is not sufficient to adversely effect biological performance (alf-life ~8-16 days).[6]

[i] SOIL — Moderate persistence. Under aerobic conditions, the soil half-life is 4 days-8 weeks.[6] Subject to microbial degradation and hydrolysis. Hydrolysis with cleavage of the ester bond occurs within c. 16 weeks.[1]

[ii] AQUATIC — Under normal temperatures and pH, cypermethrin is stable to hydrolysis (Half-life ~>50 days).[6] Cypermethrin is more stable in acidic than in alkaline media, with an optimum stability of pH 4.

[iii] ATMOSPHERIC - Not identified.

[iv] PHYTODEGRADATION — This chemical has good residual activity on treated plants.[1] When applied to wheat, residues declined to 0.2 ppm within 27 days.[6]

[v] OTHER - Not identified.

6. TOXICITY

LD$_{50}$ oral values for cypermethrin depend on such factors as: carrier, cis/trans ratio of the sample, species, sex, age and degree of fasting.[1]

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	250-4150 mg/kg		1
Rat	NOEL 2y	7.5 mg/kg		1
Mouse	LD$_{50}$ oral	138 mg/kg		5
Rabbit	LD$_{50}$ dermal	>2400 mg/kg		2
Dog	NOEL 2y	5.0 mg/kg		1
Human	ADI	0.05 mg/kg b.w.		1
Chicken	LD$_{50}$ oral	>2000 mg/kg		1
Mallard	LD$_{50}$ oral	>4640 mg/kg		6
Rainbow trout	LC$_{50}$ 96h	0.69 µg/L		1
Rainbow trout	LC$_{50}$ 24h	55.0 ppb	Technical grade	5
Bluegill sunfish	LC$_{50}$ 96h	0.0018 mg/L		6
Atlantic salmon	LC$_{50}$ 96h	1.4-12.0 µg/L	Juveniles	5
Sheepshead minnow	LC$_{50}$ 96h	2.37 µg/L		1
Daphnia	*EC$_{50}$ 48h*	*0.15 µg/L*		*1*

[i] TOXICITY (OTHER) — Under field conditions, fish are not at risk from normal agricultural usage.[1] Highly toxic to honeybees under laboratory tests, but field applications at recommended dosages do not put hives at risk (LD$_{50}$ oral 0.035 µg/bee).[1] This chemical is a slight skin irritant, a mild eye irritant, and may have a weak skin sensitizing potential. Practically non-toxic to birds. Metabolized and eliminated significantly more slowly in fish.[6] It is a potent and stable neurotoxicant. Produces no serious effects on reproduction in rats and their offspring.[7] It appears not to alter mammalian brain neurochemicals, so may provide favourable selectivity for insects compared with mammals.[10] Non-teratogenic.

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL - Residues of cypermethrin are not likely to exceed 0.2 mg/kg for meat (in the fat) and 0.05 mg/kg for muscle, liver, kidney, and milk.[11] In rats, cypermethrin is rapidly metabolized by hydroxylation and cleavage; over 99% is eliminated within hours.[6]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. PP
7. Ahmed, N. and P.K. Gupta (1988) Reproduction (one generation) toxicity of cypermethrin in rats. *J. Environ. Biol.*, 9: 149-156.
8. Chester, G., *et. al.* (1987) Worker exposure to, and absorpiton of, cypermethrin during aerial application of an "Ultra Low Volume" formulation to cotton. *Arch. Environ. Contam. Toxicol.*, 16: 69-78.
9. Dina, S.O (1988) Timing the application of deltamethrin and cypermethrin for the control of insect pests of cowpea *Vigna unguiculata* (L.) *Walp. Trop. Pest. Manage.*, 34: 65-67.
10. Raviprakash, V., Y. P. Singh and P. K. Gupta (1987) Cumulative effect of cypermethrin on brain monoamine levels in mice. *J. Environ. Biol.*, 8: 357-359.
11. Pesticide Residues in Food-1986. Evaluations 1986. Part I., Residues., FAO Plant Prod. Prof. Pap., Vol. 78: 139-144.

2,4-D

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — 2,4-D (BSI, E-ISO, F-IS4O, WSSA); 2,4-PA (JMAF)

[ii] TRADE NAME — Agricorn D (FCC); Amsol 2,4-D, Estasol 2,4-D (Rhone-Poulenc Can. Inc.); PAR III (United Agri Products); Killex Green Cross 500 Turf (Monsanto Canada Inc.). Other names include Calmix, Atra Pell, and Later's.

[iii] CHEMICAL NAME — (2,4-dichlorophenoxy) acetic acid

[iv] CAS # — 94-75-7

[v] TYPE / MODE OF ACTION— Aryloxyalkanoic acid. Selective systemic phenoxy herbicide. Absorbed by roots and foliage depending on formulation and accumulates at root/shoot meristems. Acts as a growth inhibitor. [1]

2. USE PATTERN

Used for post-emergence control of annual/perennial broad-leaved weeds in cereals, pasture, turf, grassland, orchards. Controls broad-leaved aquatic weeds. Isopropyl ester can also act as a growth regulator by preventing early fruit fall in citrus. [1] Compatible with mecoprop, dicamba, dichlorprop, MCPA, MCPB.

[i] APPLICATION —Avoid spray drift. High volatile esters may cause vapour damage to susceptible crops. [2]

Coarse sprays less likely to drift. [4] Best applied when weeds are young and actively growing. Some formulations can be applied as aerial spray. For aquatics, apply granules evenly over water surface, when weeds are actively growing but before they have formed dense mats.[3] PRE-EMERGENCE: As a band or broadcast treatment, 3-4 days after planting corn.[3]

[ii] RATES — POST-EMERGENCE: Cereals and forage crops, 0.55-2.3 L/ha. Pasture and rangeland, 1.8-5.8 L/ha at time of rapid growth. Field corn, 0.55-1.1 L/ha before 6-leaf stage. Aerial applications, on stubble and uncropped land only, minimum of 30 L/ha.

CARRIER: Water or diesel oil depending on formulation. Agitation is needed for some formulations.

[iii] FORMULATIONS

1. Water soluble sodium and ammonium salts
2. Amine salts.
3. High and low volatile esters.
4. 10-20% granules, 5-6 EC, 0.60 kg oil soluble concentrate/litre. Solid mixed with oil solutions, fertilizers and others.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 50 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store at temperatures over 0°C. If subjected to freezing temperatures, warm to 5°C and mix thoroughly. Non-flammable (acids and salts). Flashpoint: approximately 65°C (ester). [2]

4. HANDLING PRECAUTIONS

Low volatile esters may become volatile above 32°C. Causes eye and skin irritation. Non-corrosive but some concentrates are deleterious to painted surfaces. Wear long-sleeved shirt, long pants, chemical-resistant gloves, socks and shoes, and protective eye wear during handling. Wash hands before eating or drinking.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Low soil persistence. Half-life < 7 days. Microbial degradation. No adverse effect on soil microbes at usual application rates. No risk of accumulation of 2,4-D in soil, from year to year.[3] Salts leached in sandy soil.

[ii] AQUATIC — Microbial degradation. Rates increase with increased nutrients, sediment load, and dissolved organic carbon. Half-life of one week to several weeks under aerobic conditions.[7] Under anaerobic conditions, half-life can exceed 80-120 days.[8]

[iii] ATMOSPHERIC — Spray subject to photo-oxidation by reaction with hydroxyl radicals. Estimated half-life < 1 day.[5]

[iv] PHYTODEGRADATION — Breakdown by a variety of biological and chemical pathways, involving hydroxylation, decarboxylation, cleavage of the acid side chain, and ring opening.[1] Metabolites transitory in nature.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	400-500 mg/kg	Male rats	6
Rat	LD_{50} oral	639-764 mg/kg	Acid	1
Rat	LD_{50} oral	3700 mg/kg	Female rats	6
Rabbit	LD_{50} dermal	>2400 mg/kg		1
Dog	LD_{50} oral	100 mg/kg	Capsules	6
Dog	2 y F.T.	0-500 ppm	No effect	6
Human	ADI	0.3 mg/kg b.w.		1
Mule deer	LD_{50} oral	400-800 mg/kg	Acid	5
Coturnix Quail	LD_{50} oral	668 mg/kg	2-month old males	6
Coturnix Quail	LD_{50} oral	>5000 ppm	Acid, males and females	5
Pheasant	LD_{50} oral	472 mg/kg	Acid	5
Mallard	LD_{50} oral	>1000 mg/kg	Acid, 3-5 month old females	5
Mallard	LD_{50} oral	>2000 mg/kg	Acid, 4 month old males	5
Chicken	LD_{50} oral	541 mg/kg	Male and female chicks	6
Chicken	20 wk F.T.	50.0-150 mg/kg	Laying hens, no adverse effect	6
Wild duck	LD_{50} oral	>1000 mg/kg		1
Wild duck	LD_{50} oral	>2025 mg/kg	2,4-D sodium	1
Chukar	LD_{50} oral	200-400 mg/kg	Acid, males and females	5
Rock dove	LD_{50} oral	668 mg/kg	Acid, males and females	5
Rainbow trout	LC_{50} 24h	3.0-4.4 mg/L	With adjuvants	6
Rainbow trout	LC_{50} 48h	2.2-3.3 mg/L	With adjuvants	6
Rainbow trout	LC_{50} 96h	100 mg/L	2,4-D diethylammonium	1
Rainbow trout	LC_{50} 96h	1.4mg/L		9
Lake trout	LC_{50} 96h	45.0 mg/L	Acid, granular 100%	5
Bluegill	LC_{50} 48h	0.9 ppm	Unspecified salt or ester	5
Bluegill	LC_{50} 48h	8.0 mg/L	With emulsifier	6
Striped bass	LC_{50} 48h	78.2 mg/L		6
Striped bass	LC_{50} 96h	70.1 mg/L	Unspecified salt or ester	5
White perch	LC_{50} 24h	55.5 mg/L		6
White perch	LC_{50} 96h	40.0 mg/L	Unspecified salt or ester	5
American eel	LC_{50} 96h	300.6 mg/L		6
Banded killifish	LC_{50} 48h	261.1 mg/L		6
Carp	LC_{50} 96h	96.5 mg/L		5
Daphnia magna	LC_{50} 48h	363-389 mg/L		5
Daphnia magna	EC_{50} 21d	235 mg/L		1
Crayfish	EC_{50} 96h	1389 mg/L		6
Fiddler crab	LC_{50} 96h	5000 mg/L		
Dungeness crab	LC_{50} 96h	>10.0 mg/L		7
Cyclops vernalis	EC_{50} 96h	8.72 mg/L	Static bioassay	6
Cyclops vernalis	EC_{50} 48h	37.42 mg/L	Static bioassay	6
Stonefly	EC_{50} 48h	44.0 mg/L	Technical grade 2,4-D	6

[i] TOXICITY (OTHER) — Some formulations may cause skin and/or eye irritation as well as nose and throat irritation. Not toxic to bees (LD_{50} oral 104.5 μg/bee).[1] Carcinogenic status not clear.[7] Compound readily absorbed through the skin and lungs.[7]

[ii] PHYTOTOXICITY – Phytotoxic to most broad-leaved crops, especially cotton, vines, tomatoes, ornamentals, fruit trees, oilseed rape and beet.[1]

7. METABOLISM

[i] ANIMAL – Near complete absorption in mammals after ingestion; nearly all the dose excreted in urine. Half-life is between 10-20 hours in living organisms. No evidence of significant accumulation in mammals or other organisms.[7]

[ii] PLANT – Involves hydroxylation, decarboxylation, cleavage of the acid side-chhain, and ring opening.[1]

8. ADDITIONAL INFORMATION

Some plants, such as the creeping thistle, may become resistant to the effects of 2,4-D, so increasing quantities must be used. Susceptible plants become malformed before they die. Exhibit characteristic twisting and curling from the increased production of starches which the plant is unable to utilize.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. CESARS
7. PP
8. Norris, L.A. (1981) The movement, persistence and fate of the phenoxy herbicides and TCDD in the forest. *Residue Reviews* 80: 66-135
9. ECOTOX

2,4-DB

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — 2,4-DB (BSI, draft E-ISO, draft F-ISO, WSSA)

[ii] TRADE NAME — Embutox (Rhone-Poulenc); Weedaway CUBUTOX 600, (Interprovincial Co-op Ltd.); Calibur 400 (United Agri Products). *2,4 D 400 (Interprovincial Co-op Ltd.); Clean Crop Calibur 400 (United Agri Products).*

[iii] CHEMICAL NAME — 4-(2,4-dichlorophenoxy) butyric acid.

[iv] CAS # — 94-82-6

[v] TYPE / MODE OF ACTION — Aryloxyalkanoic acid. A phenoxy compound used as a selective post-emergence, translocated herbicide. 2,4-DB is absorbed only through the foliage. Weeds are susceptible due to the very rapid conversion of 2,4-DB to 2,4-D. Most legumes convert it slowly, making them resistant.[3]

2. USE PATTERN

Herbicide to be used on alfalfa, clovers, forage legumes, peanuts, soybean, trefoil and nurse crops. Effective against broadleaf weeds of many varieties and algae. Not effective on grasses or established broadleaves.[3]

[i] APPLICATION — Use as a band or broadcast treatment and sometimes aerially. Apply after the crop has started growth and when weeds are small. Post-emergence directed spray to soybeans should be done when soybeans are actively growing and are 20-30 cm tall. Nurse crops of barley, oats and wheat underseeded to legumes may be treated when the nurse crop is 1.5-15 cm tall. Do not apply with a wetting agent. Do not feed treated forage or crop residue to livestock within 30 days of treatment. Treated weeds should be dead within 3 weeks.[3]

[ii] RATES — 0.22-2.2 kg a.i./ha in 46-55 litres of water.

CARRIER: Can be water or oil.

[iii] FORMULATIONS

1. EC **(formulated as amine salts and esters)**
2. SL
3. SC
4. Amine salts are soluble in water while esters are soluble in oil and emulsifiable in water.[3]

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

Non-corrosive. No shelf life limitations.

4. HANDLING PRECAUTIONS

Do not treat if temperatures go over 32°C or under 4.4°C in the following few days. Do not apply pre-emergence. Avoid drift. Do not apply with a wetting agent.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Microbial degradation to 2,4-D. Half-life in soils 7 days.[1]

[ii] AQUATIC – Microbial degradation to 2,4-D

[iii] ATMOSPHERIC – Butyric acid can exist in both vapor and particulate phases. Physical removal from the atmosphere can occur through both wet and dry deposition.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>2000 mg/kg	Butoxone	2
Rat	LD_{50} oral	370-700 mg/kg	2,4-DB sodium	1
Mouse	LD_{50} oral	400 mg/kg	2,4-DB sodium	1
Rabbit	LD_{50} dermal	>10,000 mg/kg		2
Dog	13 weeks	diet of 8.0 mg/kg	No effect level	
Pekin duckling	LC_{50} 8d	>1000 mg/kg		
Rainbow trout	LC_{50} 96h	c. 4.0 mg/L	Amine salt and esters	1
Fathead minnow	LC_{50} 96h	14.0 mg/L	Amine	
Fathead minnow	LC_{50} 96h	7.0 mg/L	Esters	

[i] TOXICITY (OTHER) — May be irritating to the eyes and skin. Not toxic to bees.[1]

[ii] PHYTOTOXICITY — Susceptible plants include cotton, tobacco, tomatoes, ornamentals. There may be some temporary injury to other crops but they will soon outgrow this without the final yields being affected.[3]

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Absorbed through foliage. Weeds should die within 3 weeks of application.

9. REFERENCES

1. PM
2. FCH
3. AC

Daminozide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — daminozide (BSI, E-ISO, F-ISO, ANSI)

[ii] TRADE NAME — Alar (Uniroyal Ltd); B-Nine (Plant Products Co. Ltd)

[iii] CHEMICAL NAME — *N*-dimethylaminosuccinamic acid

[iv] CAS # — 1596-84-5

[v] TYPE / MODE OF ACTION— Growth retardant.

2. USE PATTERN

Plant growth regulator used in top fruit to improve balance between vegetative growth and fruit production. Capable of inducing desirable effects on vegetative growth, flowering and fruiting of many crops. B-Nine inhibits internodal elongation in chrysanthemums, azaleas, hydrangeas and promotes flowering in azaleas. It also increases heat, drought, and frost resistance.[5]

[i] APPLICATION — As foliar spray top runoff at 1500-10,000 mg/L; use higher concentrations under conditions of low humidity. Best results obtained when plants are well-watered and turgid. Two applications at 1/2 rate may be more effective than one on ornamentals. Foliage should be dry at time of treatment. Do not wash foliage for 6-12 hrs after spraying. Do not add wetting agents.[3] Avoid using high-pressure spray equipment.

[ii] RATES — 1.1-8.9 kg/ha.[3]; 1.5-10.2 g a.i./L

CARRIER: Water.

[iii] FORMULATIONS

1. SP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable, water soluble crystals. Corrosive to metals. Prevent from freezing. Store in a cool place. Incompatible with wetting agents, alkaline materials, oils and copper-containing compounds.[1]

4. HANDLING PRECAUTIONS

Do not graze orchards or feed peanut hay or forage to livestock. Avoid contact with skin, eyes and clothing. Do not contaminate any body of water. Do not mix with other chemicals such as insecticides, fertilizers, herbicides or fungicides.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Quickly dissipates in soil with most residues becoming bound, with some CO_2 formation. In aerobic soil, half of the daminozide is no longer recoverable after 17 hours.[1] Subject to degradation by soil microorganisms. The half-life of daminozide in sil is approximately 21 days. Soluble in water and very mobile in soils, unlikely to contaminate groundwater as it does not persist in soil.[6]

[ii] AQUATIC – Degrades to UDMH.[6]

[iii] ATMOSPHERIC - Not identified.

[iv] PHYTODEGRADATION — Rapidly translocated to all parts of plant. Not metabolized by American elm seedlings.[4]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	8400 mg/kg		2
Rabbit	LD_{50} dermal	>1600 mg/kg		2
Rat	LC_{50} inhalation 1h	>147 mg/L air		1
Bobwhite quail	LC_{50} dietary 8d	>10000 mg/kg		1
Rainbow trout	LC_{50} 96h	149 mg/L		1
Bluegill sunfish	LC_{50} 96h	423 mg/L		1

[i] TOXICITY (OTHER) — Non-toxic to fish and wildlife.[3] Two year feeding study on rats and dogs showed no effect at 3000 ppm (largest dosage tested).[2] Not toxic to bees.[1] May cause skin or eye irritation.[6] Does not appear to affect reproduction.[6] May be teratogenic at very high doses. Non-mutagenic.[6]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Metabolites include 1,1-dimethylhydrazine.[1]

8. ADDITIONAL INFORMATION

Do not mix with other pesticides, alkaline materials, oil, or Cyprex. Do not use on plants that are under stress. Monocots do not respond; almost all dicots give some response. Translocated through foliage.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Domir, S.C.(1980) ^{14}C-daminozide and ^{14}C-maleic hydrazide in American elm (*Ulmus americana* L.). *Pestic. Sci.* 11: 418-422.
5. Green, M.B., G.S. Hartley and T.F. West (1977) *Chemicals for Crop Protection and Pest Control*. Pergamon Press: Oxford, New York, Toronto. 290 pp.
6. PP

Dazomet

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dazomet (BSI, E-ISO, F-ISO, WSSA, JMAF); tiazon (USSR); DMTT (former WSSA)

[ii] TRADE NAME — Alchem, Nalcon (Alchem Inc); Metasol (Calgon Corporation); Diachem (Diachem); Biosperse (Drew Canada)

[iii] CHEMICAL NAME — 3,5-dimethyl-1,3,5-thiadiazinane-2-thione

[iv] CAS # — 533-74-4

[v] TYPE / MODE OF ACTION— Pre-plant soil fumigant used on germinating annual and perennial weeds, nematodes, soil fungi, and soil insects. Also used as a slimicide and material preservative.

2. USE PATTERN

Used on numerous crops, as a slimicide in pulp and paper manufacture, and as a preservative in leather, starch, casein, and glue.

[i] APPLICATION — Applied as a fumigant in soil to a depth of 20-25 cm. Soil should then be sealed and lightly irrigated so a crust forms on the surface. The soil should be irrigated 3-5 days after application so the top layer doesn't dry out. Toxic fumes must disappear before planting. Depending on soil type, 10-40 days are needed for gases to disappear from soil.

[ii] RATES — 84.0-1121 kg/ha; 30.0-120 ppm into water as a slimicide; 0.06-0.48 kg a.i./tonne dry weight stock.

CARRIER – Water.

[iii] FORMULATIONS

1. SN
2. GR
3. WP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Moderately stable but sensitive to heat (>35°C) and moisture. Decomposes if stored at temperatures above 36°C. Acid hydrolysis yields carbon disulphide. Dust formulation not corrosive to tin-plate if kept dry. Store in a dry, cool place. Keep containers tightly sealed when not in use.

4. HANDLING PRECAUTIONS

Wear rubber gloves to handle. Toxic to all growing plants so it is advisable to keep 3-4 feet away from growing plants. Do not plant within the drip-line of trees and shrubs. Toxic to plants if planted 3 weeks after treatment.[3] Vapours are injurious to crops.[3] Do not use at temperatures above 32°C.

5. ENVIRONMENTAL PERSISTENCE

Chemical degradation occurs 10-15 minutes after application, forming methyl isothiocyanate, formaldehyde, hydrogen sulphide, and monomethylamine.[3] Average field half-life is 7 days, dazomet does not accumulate in soil[4]

[i] SOIL — Persists in soil for about 4 days. Breaks down in soil to methyl (methylamino-methyl) dithio-carbamic acid which in turn yields methyl isothiocyanate.

[ii] AQUATIC – If released into water, dazomet is not expected to adsorb to suspended solids and sediment based upon its estimated K_{oc} value. Hydrolysis half-lives at pH values of 5.7, 7.0 and 8.0 are 2.4, 2.8, and 4.2 hours, respectively, in freshwater; in salt water, a half-life of 6.1 hours is expected.[5]

[iii] ATMOSPHERIC – Vapor-phase dazomet will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 1.3 hours. Particulate-phase dazomet will be removed from the atmosphere by dry deposition; hydrolysis of this compound during rain events or in clouds may occur.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	640 mg/kg	Technical grade	2
Rat	LD_{50} oral	520 mg/kg		1
Mouse	LD_{50} oral	710 mg/kg	Females	1

[i] TOXICITY (OTHER) — Dust is irritant to skin and eyes of rabbits.[3] Toxic to fish. Not toxic to bees when used as directed.[1]

[ii] PHYTOTOXICITY — Strongly toxic to all growing plants. Treated soil should not be planted until shown to be free of the compound and its decomposition products,[1] generally within 90 days, by normal germination of cress seed sown on sample of treated soil.

7. METABOLISM

[i] ANIMAL – Not readily absorbed by the skin.[5]

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

Does not accumulate in soil. Soil pH does not affect action.[3] No longer marketed as agricultural chemical in U.S. As it contains 17.3% nitrogen, some increase in plant growth has occurred due to this fertilizer benefit.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. HSDB

Deltamethrin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — deltamethrin (BSI, E-ISO); deltamethrine (F-ISO).

[ii] TRADE NAME — Decis (Aventis CropScience Canada Co.)

[iii] CHEMICAL NAME — (*S*)-a-cyano -3 -phenoxybenzyl (1*R*,3*R*)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate.

[iv] CAS # — 52918-63-5

[v] TYPE / MODE OF ACTION— Synthetic pyrethroid compound used as a stomach poison and contact insecticide.

2. USE PATTERN

For use against a wide range of insects for the protection of top fruit, vegetables, ornamentals (greenhouses), shelterbeds, tobacco, and other field crops. Also used on non-crop land. It has good residual activity for outdoor uses (cattle dip and mosquito control) and indoor uses (crawling and flying insects, stable flies, and stored products insects).

[i] APPLICATION — Apply when insects first appear and repeat if necessary. Control of the pea pod borer is best when three applications are made from 35-49 days after planting. The pea pod bug is better controlled when the three applications are more spread out (35-56 days after planting).[5] Stored cereal grains may be protected against insect attack either by direct applications or by treatment of the storage premises.[7] No more than three applications should be applied yearly, and no more than two when applied by air.

[ii] RATES — 2.5-25.0 g a.i./ha.in 10-1000 L water. For stored grain 0.5 g a.i./ton of grain is sufficient for >1 year storage.[7]

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. SV

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 17 m
2. Air blast application: Calculated: 15(24)-17(26) m
3. Aerial application: Label: 100 m
4. Forestry application: Not identified.

3. STORAGE

This compound is stable on exposure to air and sunlight, and more stable in acid than alkaline media. Should be stored in original containers away from foodstuffs and animal feed.

4. HANDLING PRECAUTIONS

Avoid contact with mouth, eyes and skin, especially with undiluted EC formulations. This product is a severe skin irritant.

5. ENVIRONMENTAL PERSISTENCE

Deltamethrin gives 7-21 days of residual insect control. At 40°C there is no breakdown of the chemical after 6 months.

[i] SOIL – In soil, undergoes microbial degradation within 1-2 weeks. No incidence on soil microflora and nitrogen cycle.[1]

[ii] AQUATIC — Disappears quickly from the surface microlayer of streams and ponds with a half-life of about 45 minutes. It is not found in sediments.[6] If released into water, deltamethrin is expected to adsorb to suspended solids

and sediment based upon its experimental K_{oc} range. Deltamethrin was found to have a water column disappearance half-life of 2-4 hrs.[8]

[iii] ATMOSPHERIC – If released to air deltamethrin will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase deltamethrin will be removed from the atmosphere by wet and dry deposition.[8]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	135->5000 mg/kg		1
Rat	LC_{50} inhalation 4h	2.2 mg/L air		1
Rat	NOEL 2y	2.1 mg/kg b.w.		11
Mouse	NOEL 2y	12.0 mg/kg b.w.		1
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Dog	LD_{50} oral	>300 mg/kg		1
Human	ADI	0.01 mg/kg		19
Mallard	LD_{50} oral	4640 mg/kg		1
Mallard	LC_{50} dietary 8d	>8039 mg/kg diet		1
Quail	LC_{50} dietary 8d	>5620 mg/kg diet		1
Rainbow trout	LC_{50} 96h	0.91 µg/L		1

[i] TOXICITY (OTHER) — Toxic to foraging honeybees (LD_{50} 50.0 ng/bee).[1] Aquatic fauna, fish, and particularly crustaceans may be affected. Low doses of deltamethrin elicit responses indicative of high levels of stress in rats.[4] Non-mutagenic and non-teratogenic.[1]

[ii] PHYTOTOXICITY — Generally non-phytotoxic when used as directed.[2] Chromosomal and mitotic abnormalities were detected in root meristems of *Allium cepa* at concentrations ranging from 0.05 to 2.0 mg/L.[3]

7. METABOLISM

[i] ANIMAL – In rats, following oral administration, elimination occurs within 2-4 days. The phenyl ring is hydroxylated, the ester bond hydrolyzed, and the acid moiety is eliminated as the glucuronide and glycine conjugated.[8] Deltamethrin has a half-life in rat brain of 1-2 days, but it is rather more persistent in body fat, with a half-life of 5 days.[8]

[ii] PLANT – No uptake through leaves and roots – non-systemic compound. No major metabolites, except in oily crops, where *trans*-deltamethrine is part of the residue definition.[1]

8. ADDITIONAL INFORMATION

This is a very broad spectrum insecticide and is considered to be the most powerful of the synthetic pyrethroids. No systemic activity has been observed.

9. REFERENCES

1. PM
2. AC
3. Chauhen, L.K.S., T.S.S. Dikshith and V. Sundararaman (1986) Effect of deltamethrin on plant cells. I. Cytological effects on the root meristems of *Allium cepa. Mutat. Res.*, 1986, Vol 171: 25-30.
4. De-Boer, S.F., et. al (1988) Changes in plasma corticosterone and catecholamine contents induced by low doses of deltamethrin in rats. *Toxicology*, 49: 263-270.
5. Dina, S.O (1988) Timing the application of deltamethrin and cypermethrin for the control of insect pest of cowpea *Vigna unguiculata* (L.) *Walp. Trop. Pest. Manage.*, 34: 65-67.
6. Pesticides-Research and Monitoring, Annual Report 1986-1987. Environment Canada.
7. Pesticide Residues in Food — 1986. Evaluations 1986 Part I, Residues, FAO Plant Prod. Prot. Pap., 78: 147-150.
8. HSDB

Diazinon

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — diazinon (BSI, E-ISO, F-ISO, ANSI, ESA, BAN, JMAF); dimpylate (former BAN name)

[ii] TRADE NAME — Clean Crop Diazinon 500 (United Agri Products); Basudin (Novartis Crop Protection); Agrox (Norac Concepts Inc., Zeneca Agro); Gardex (Gardex Chemicals Ltd.); *Pestroy (Pestroy Chemical Company Ltd.).* Other names include D-fend, Thorokill, Knockout, Mystericuse,Win, Bexcol, and Bikoe.

[iii] CHEMICAL NAME — *O,O*-diethyl *O*-2-isopropyl-6-methylpyrimidin-4-yl phosphorothioate

[iv] CAS # — 333-41-5

[v] TYPE / MODE OF ACTION — Organophosphorous insecticide, nematicide (phosphorothioate group), and acaricide with stomach, contact, and respiratory action. Cholinesterase inhibitor.

[vi] NOTICE — In Canada, production of residential and commercial indoor diazinon use products was ended in 2001. **Commercial products used non-agriculturally on lawn and turf are expected to be phased out by the end of 2003/2004**. **Agricultural uses are being re-evaluated** and may have additional risk mitigation measures applied with some products eventually being phased out for use in Canada. The US EPA published a cancellation order for all end-use products containing diazinon, effective March 6, 2001. This order terminated all indoor use as well as certain agricultural and non-agricultural uses because of concerns with potential exposure risks to human health and the environment. This order also begins the process to cancel around 20 different food crop uses in the United States.

2. USE PATTERN

For control of soil insects (*e.g,*. cut worms, wire worms, maggots). Controls many pests in fruit, vegetables, tobacco, forage and field crops, range, pasture, grassland, and ornamentals as well as in outdoor living areas. Used extensively to control many household insects, cockroaches, grubs and nematodes in turf, and flies in greenhouses and mushroom barns. Veterinary use against flies and ticks.

[i] APPLICATION — With common application equipment at uniform rate on fruits and vegetables. Repeat as necessary. Livestock barns treated for houseflies: residual control up to 8 weeks. Remove livestock for at least 4 hours after treatment. Sheep can be dipped in dilute solution for fly, lice, tick and flea control. Apply to sheep as spray at least 14 days before slaughter. May be applied to soil as a pre-plant insecticide. Also used in treated wearing apparel and ear tags.

[ii] RATES — Fruit crops, 0.25-0.75 kg a.i./1000 L spray. Vegetable crops, 0.55-1.1 kg a.i./ha. Ornamentals, 0.5-1.88 kg a.i/ha. 4.83 g a.i./L water for residual fly control in farm buildings.[3] Ear tags, 1-2 tags/animal (2.1 g a.i./ tag). Solubility in water is 0.004% at room temperature. Soluble in petroleum oils.

CARRIER: Water, petroleum oils.

[iii] FORMULATIONS

1. WP
2. GR
3. SN
4. DU
5. EC
6. PP
7. MS
8. SR

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Calculated: 1-2(4) m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable in alkaline media; slowly hydrolyzed in water and dilute acid. Shelf-life is 3-5 years if stored in a dry place under minimum temperatures.[2] Presence of traces of water promotes hydrolysis on storage to highly poisonous tetraethyl monothiopyrophosphate. Decomposes above 120°C.[1]

4. HANDLING PRECAUTIONS

Incompatible with copper containing compounds.[1]

5. ENVIRONMENTAL PERSISTENCE

Long residual effects. Does not persist for lengthy periods in either plant or animal tissues.

[i] SOIL — Low mobility as diazinon is strongly adsorbed to soil (Half-life ~2-4 weeks).[6] Bacterial degradation is the major fate process. Rapidly degraded. *Flavobacterium* spp. are capable of degrading diazinon *in vitro* and in soil.[7] Chloroform, pasteurizing, wetting/drying or freeze/thawing did not prevent degradation.[7]

[ii] AQUATIC — Hydrolysis may be the major fate process. Half-life of 185 days at pH 7.4. [4] May sorb to sediment but it is not expected to bioaccumulate.[4]

[iii] ATMOSPHERIC - If released to air, diazinon will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase diazinon will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 4 days. Particulate-phase diazinon will be removed from the atmosphere by wet and dry deposition.[4]

[iv] PHYTODEGRADATION — Half-life is short (~2-14 days) in leafy vegetables, forage crops, and grass.[6] Rapid absorption and translocation. Hydrolysis produces hydroxypyrimidine derivatives which are degraded to carbon dioxide.[1]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	300-400 mg/kg	Technical grade	6
Rat	LD_{50} dermal	>2150 mg/kg		1
Rat	NOEL 90d	0.1 mg/kg/d		1
Mouse	LD_{50} oral	80.0-135 mg/kg		1
Rabbit	LD_{50} dermal	540-650 mg/kg		1
Dog	NOEL 90d	0.02 mg/kg/d		1
Monkey	2y feeding	0.05 mg/kg/d	No effect level	9
Human	ADI	0.002 mg/kg b.w.		1
Mallard	LD_{50} oral	3.54 mg/kg		4
Chicken	LD_{50} oral	8.4 mg/kg		5
Pheasant	LD_{50} oral	4.33 mg/kg		5
Rainbow trout	LC_{50} 96h	2.6-3.2 mg/L		6
Brook trout	LC_{50} 96h	0.45-1.05 mg/L		5
Bluegill sunfish	LC_{50} 96h	16.0 mg/L		1
Bluegill sunfish	LC_{50} 96h	0.168 mg/L		4
Carp	LC_{50} 96h	7.6-23.4 mg/L		1
Fathead minnow	LC_{50} 96h	6.6-10.0 mg/L	Under flow-through conditions	5
Sheepshead minnow	LC_{50} 96h	1.4 mg/L		5
Crayfish	EC_{50} 48h	0.537 mg/L		5
Gammarus lacustris	LC_{50} 96h	0.2 mg/L		4
Gammarus lacustris	EC_{50} 48h	0.5 mg/L	Static bioassay	5
Hyalella azteca	EC_{50} 48h	0.022 mg/L		5
Daphnia	EC_{50} 24h	1.4 mg/L		1

[i] TOXICITY (OTHER) — Cholinesterase inhibitor. Non-teratogenic or embryotoxic in hamster and rabbit at low doses. No accumulation in tissues or organs; metabolism and excretion in urine and faeces fairly rapid. Highly toxic to birds, honey bees, and fish.[6] Slightly toxic to earthworms.[1] Mild eye and skin irritation in rabbit (technical product).

[ii] PHYTOTOXICITY — Non-phytotoxic except to Stephanotis and African violet. Russeting on green and yellow apples has occured. Some lettuce varieties are injured.

7. METABOLISM

[i] ANIMAL – Oxidized *in vitro* to diazoxon and further to diethylphosphorothoic acid. Further degradation occurs *in vitro* with urinary metabolites, which are less toxic than parent compound. 50% of diazinon metabolite is excreted within 12 hrs. No accumulation detected in tissues. Pyrimidine ring not broken during metabolism.[8] Cattle exposed to diazinon may store the compound in fat for a short time, and applications to skin resulted in trace amounts in milk within 24 hours.[6]

[ii] PLANT – Rapid absorption and translocation in plants. Metabolism proceeds via hydrolysis and subsequent transformation and degradation of the hydroxypyrimidine derivatives to CO_2.[1]

8. ADDITIONAL INFORMATION

Significant amount of reduction in residues will take place during washing, preparation, and processing of food for consumption.[9] Do not mix with copper compounds. No off-flavours on harvested fruits and vegetables. Compatible with other pesticides. Toxic deterioration products formed on storage if water present.

9. REFERENCES

1. PM
2. FCH
3. PMRA
4. HSDB
5. CESARS
6. PP
7. Forrest, M, K.A. Lord, N. Walker and H.C. Woodville (1981) The influence of soil treatments on the bacterial degradation of diazinon and other organophosphorus insecticides. *Environ. Pollut.*, Ser. A, 24: 93-104.
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Dicamba

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dicamba (BSI, E-ISO, F-ISO, ANSI, WSSA); dianat (former exception USSR); MDBA (JMAF)

[ii] TRADE NAME — Dycleer (Syngenta Crop Protection Canada Inc.); Banvel, Dyvel, Mirage, Marksman, Cadence (BASF Canada Inc.); Takkle D Weedkiller (Zeneca Agro); Botanix (Les Industries Nobel); Mocan 943 (Monsanto Canada Inc); Trillion (Plant Products Co. Ltd); Target, Kil-mor (Novartis Crop Protection); Par III (United Agri Products); Chempara Biocide; *Rona (Groupe Rona Dismat).*

[iii] CHEMICAL NAME — 3,6-dichloro-*o*-anisic acid

[iv] CAS # — 1918-00-9

[v] TYPE / MODE OF ACTION — A selective systemic herbicide, one of the benzoic acids. Absorbed by leaves and roots and translocated throughout the plant. Acts as an auxin-like growth regulator.[1]

2. USE PATTERN

For control of brush under utility lines, along highways and railroads, and for the control of both annual and perennial broadleaf weeds in corn, sorghum, small grains, rangeland, pastures, turf, non-cropland, and fallow land. Particularly useful against field bind weed, smart weed, Canada thistle, and wild buckwheat in oats, spring wheat, and corn.

[i] APPLICATION — By spraying in water solution (ground or aerial) or as granules, by basal application, and pre-emergence and post-emergence. Do not apply in the dripline of desired trees.

[ii] RATES — Wheat, Rye, Oats, 0.11-0.14 kg a.i./ha. Corn, 0.29-0.6 kg a.i./ha. Pasture and rangeland, 1.0-2.21 kg a.i./ha in 110-220 L water.[5] The very low rates are for the selective killing of annual broadleaves, higher rates are for total weed control.

CARRIER: Water, applied at 22 to 1000 L/ha — no additional surfactant or agitation necessary. Attapulgite, vermiculite, and liquid and dry fertilizers also have been used as carriers.

[iii] FORMULATIONS

1. SN
2. SP
3. WG
4. EC
5. SU
6. GR
7. PE

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Calculated: (1.5) 1.1 m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

All formulations tested are extremely stable. Resistant to oxidation and hydrolysis under normal conditions.[6] Stable to acids and alkalis. Decomposes at 200°C[1]

4. HANDLING PRECAUTIONS

Avoid drift. Do not use on corn grown on sandy or sandy loam soils low in organic matter. Do not graze corn for dairy feed prior to maturity.[3] Precipitation of the free acid from water may occur if the dimethylammonium salt is combined with lime sulfur, heavy metal salts, or strongly acidic materials.[1]

5. ENVIRONMENTAL PERSISTENCE

Disappears within several weeks or months depending on the weather. Metabolism by microorganisms appears to be the major degradation pathway under most conditions.

[i] SOIL — Moderately persistent and highly mobile. Microbial degradation occurs with 3,6-dichlorosalicylic acid as a major metabolite.[1] Half-life ~<14 days under suitable conditions.[8] Biodegradation increases with temperature and soil moisture.[8]

[ii] AQUATIC — Microbial degradation and photolysis are the main routes of dicamba disappearance.[8]

[iii] ATMOSPHERIC — Half-life for vapour-phase reaction with hydroxyl radicals is c. 2.42 days.[6]

[iv] PHYTODEGRADATION — Degradation rates vary greatly with species.[1] No detectable levels found 90 days after application of 0.1 mg/kg in wheat or barley. Absorbed residues appeared to be degraded to other products. Metabolized in plants to herbicidally inactive 2,5-dichloro-3-hydroxy-6-methoxybenzonic acid. Some volatilization may occur from plant surfaces.[6]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	757-1707 mg/kg		8
Rat	LD_{50} oral	6764 mg/kg	Dicamba-sodium	1
Rat	NOEL 2y F.T.	500 mg/kg diet	No ill effect	1
Mouse	LD_{50} oral	1190 mg/kg		8
Rabbit	LD_{50} dermal	>2000 mg/kg		2
Dog	NOEL 2y F.T.	50.0 mg/kg diet	No ill effect	1
Mallard	LD_{50} oral	2000 mg/kg		1
Hen	LD_{50} oral	673 mg/kg	Salt	4
Pheasant	LD_{50} oral	800 mg/kg	Salt	4
Bobwhite quail	LC_{50} dietary 8d	>10000 mg/kg		1
Rainbow trout	TLm 24h	35.0 mg/L	Administered in acid form	4
Rainbow trout	LC_{50} 48h	35.0 mg/L		2
Rainbow trout	LC_{50} 96h	28.0 mg/L		7
Rainbow trout	LC_{50} 96h	135 mg/L	Technical grade	8
Bluegill sunfish	TLm 24h	130 mg/L	Acid	4
Bluegill sunfish	LC_{50} 48h	40.0 mg/L		8
Bluegill sunfish	LC_{50} 96h	23.0 mg/L		7
Bluegill sunfish	LC_{50} 96h	135 mg/L	Technical grade	8
Carp	TLm 24h	659 mg/L	Administered in salt form	4
Carp	LC_{50} 48h	465 mg/L		2
Sheepshead minnow	LC_{50} 96h	>180 mg/L		8
Fiddler crab	LC_{50} 96h	>180 mg/L		8
Gammarus fasciatus	LC_{50} 96h	>100 mg/L	Static bioassay	6
Gammarus lacustris	LC_{50} 96h	3.9 mg/L		7
Daphnia	EC_{50} 48h	>100 mg/L	Technical grade	6

[i] TOXICITY (OTHER) — Low toxicity to wildlife and fish.[4] Chronic toxicity has not been proven as dicamba (acid) is readily excreted. No effect on reproduction in rats.[4] Distribution and elimination of dicamba was studied in rats following single intervenous injections. The elimination of dicamba from the blood was rapid with a biological half-life of 0.64 hours (following 100 mg/kg).[6] Not toxic to bees (LD_{50} 3.6 µg/bee).[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not stored in tissues. Dicamba is rapidly absorbed into the bloodstream from the gastrointestinal tract.[8] In mammals, following oral administration, dicamba is rapidly eliminated in the urine.[1] In mice, rabbits, rats, and dogs, 85% of an oral dose was excreted as unmetabolized dicamba within 48 hours of dosing.[8]

[ii] PLANT – The degradation rate in plants varies greatly with species.[1]

8. ADDITIONAL INFORMATION

Compatible with most pesticides. In mixtures with 2,4-D or 2,4-D and dichlorprop, effective for brush control, especially in conifers.[9]

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. PMRA
6. HSDB
7. CESARS
8. PP
9. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control*. 101 pp.

Dichlobenil

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dichlobenil (BSI, F-ISO, ANSI, WSSA); DBN (JMAF)

[ii] TRADE NAME — Casoron (Crompton Co.); Sanafoam (Airrigation Engineering Co. Inc.); Root X (Genreal Chemical Co.).

[iii] CHEMICAL NAME — 2,6-dichlorobenzonitrile

[iv] CAS # — 1194-65-6

[v] TYPE / MODE OF ACTION— An aromatic nitrile compound used as a pre-emergence selective herbicide. Dichlobenil is a powerful inhibitor of germination and actively-dividing meristems.[1] This may result in the swelling or collapse of stem, root, and petiole and a general brown discoloration, frequently accompanied by the exudation of gummy material from shoots. Leaves may abciss and exhibit black discoloration.[4]

[vi] NOTICE — In January of 2002, U.S. EPA revoked certain residue tolerances for dichlobenil due to the cancellation of food usage for dichlobenil containing pesticides.

2. USE PATTERN

Used for the control of annual and perennial weeds in apples, grapes, cranberries, blueberries, alfalfa, pears, plums, peaches, ornamentals, shelterbelts, and non-crop areas (for total vegetation control). Also used for aquatic weed control.

[i] APPLICATION — The WP formulation must be agitated while spraying.[3] AQUATIC WEEDS: Treat in the very late fall or early spring before emergence of weeds. Do not use fish for 90 days after application. Do not use in shellfish waters. CRANBERRIES: Apply in spring, prior to bloom or post-harvest in the fall.[3] ORCHARDS: Apply before weeds germinate. If soil is dry, shallow incorporation is effective. Apply to established trees.[3] ALFALFA and CLOVER: Apply during dormant period.[3]

[ii] RATES — AQUATIC: 4.5-17.0 kg a.i./ha, depending upon the depth of the body of water. TERRESTRIAL: 4.4-22 kg a.i./ha, depending on weed species to be controlled.

CARRIER: Water.

[iii] FORMULATIONS

1. SN
2. GR
3. WP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Non-corrosive. Shelf-life in storage is at least two years when stored in a cool, dry place. Due to its volatility, the product is packed in tightly closed containers. It is thermally stable. Stable to light and heat. Stable at pH 5-9, but rapidly hydrolyzed by strong alkali to 2,6-dichlorobenzamide.[4] Compatible with most WP- or WG-formulated herbicides. Mixing with liquid fertilizers or EC-formulated herbicides is not recommended[4]

4. HANDLING PRECAUTIONS

Do not breathe dust. Do not allow contact with eyes or skin. Avoid contamination of food or feed. In sandy soils lower dosages should be applied.[4] Do not apply until 6 months after rooting of cuttings in the field. Do not graze treated areas.

5. ENVIRONMENTAL PERSISTENCE

Generally effective for a period of 2-6 months. Under favorable conditions, up to 1 year.[4]

[i] SOIL — Half-lives of 1.5 months and 12 months have been reported.[5] Dichlobenil does not build up in the soil, and does not move in the soil to any great extent.[3] Under conditions of high moisture loss from soil, the loss of dichlobenil

may be very rapid due to its volatility.[4] Microbial breakdown in soils is slow, the primary metabolite being 2,6-dichlorobenzamide (BAM). This product is more subject to leaching then the parent compound.[4]

[ii] AQUATIC — Dichlobenil is stable to photolysis, hydrolysis, and probably oxidation.[5] The reported half-life is 3.65 to 23.1 days.[5] Release to water will result in significant biodegradation and volatilization. The compound is not expected to persist in the aqueous environment. Dichlobenil is not expected to bioconcentrate.[8]

[iii] ATMOSPHERIC – 92 day half-life on estimation for the vapour-phase reaction with hydroxyl radicals in the atmosphere.[9]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	4460 mg/kg		1
Rat	NOEL 2y	50.0 mg/kg diet		1
Rat	NOEL 2-gen F.T.	60.0 mg/kg diet		1
Mouse	LD$_{50}$ oral	1014 mg/kg	Males	1
Mouse	LD$_{50}$ oral	1621 mg/kg	Females	1
Rabbit	LD$_{50}$ dermal	>2000 mg/kg		1
Rabbit	84d F.T.	50.0 mg/kg diet	No-effect level	7
Human	ADI	0.025 mg/kg b.w.		1
Bobwhite quail	LC$_{50}$ dietary 8d	c. 5200 mg/kg diet		1
Pheasant	LC$_{50}$ 8d	1500 mg/kg diet		7
Guppy	LC$_{50}$ 48h	18.0 mg/L		7
Coldwater Fish	LC$_{50}$	6.3 mg/L	Moderately toxic	2
Warmwater fish	LC$_{50}$	5.7-8.3 mg/L	Moderately toxic	2
Aquatic inverts	EC$_{50}$	3.2 mg/L	Moderately toxic	2
Daphnia	*LC$_{50}$ 48h*	*6.2 mg/L*		*1*

[i] TOXICITY (OTHER) — No adverse effects on wildlife have been reported.[4] Not acutely toxic to fish at recommended dosages.[4] Slightly toxic to game birds.[2] Not toxic to bees.[1] The major metabolite BAM is moderately toxic to aquatic species and is very persistent.[6] In rats, subchronic ingestion of BAM produces a neuromuscular effect not observed with the parent compound.[2] Harmless to carabids, no effect on soil micrflora.[1] Non-mutagenic.[4]

[ii] PHYTOTOXICITY – Some conifers are susceptible to dichlobenil vapour, due to their bark structure.[1]

7. METABOLISM

[i] ANIMAL – Metabolised and excreted mainly as hydroxylated conjugates.[1]

[ii] PLANT - In plants, this compound is absorbed from the soil and accumulates in the roots. BAM is readily transported in the transpiration stream and may be present in the leaves.[4] A percentage of root-absorbed dichlobenil is lost by evaporation from leaf surfaces. Dichlobenil is hydroxylated in plants, followed by conjugation.[4]

8. ADDITIONAL INFORMATION

When applied to existing weeds, control may take 2-3 weeks to be seen.[3]

9. REFERENCES

1. PM
2. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
3. AC
4. HH
5. Reinert, K.H. and J.H. Rodgers (1987) Fate of aquatic herbicides. *Rev. Environ. Contam. Toxicol.*, 98: 61-98.
6. VanLeeuwen, C.J. and H. Maas (1985) The aquatic toxicity of 2,6-dichlorobenzamide (BAM), a degradation product of the herbicide dichlobenil. *Environm. Poll.* (Series A), 37: 105-115.
7. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
8. HSDB
9. IH

1,3-Dichloropropene

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — 1,3-dichloropropene (BSI, E-ISO); dichloro-1,2 propene (F-ISO); D-D (JMAF)

[ii] TRADE NAME — Telone II, Telone C-17 (DOW Agrosciences Canada Inc.); Vortex Plus, Vortex Plus CP (Agrevo Canada Inc.).

[iii] CHEMICAL NAME — (EZ)-1,3-dichloropropene

[iv] CAS # - 542-75-6

[v] TYPE / MODE OF ACTION — Soil fumigant nematicide[1]

2. USE PATTERN

Pre-planting control of most species of nematode in deciduous fruit and nuts, citrus fruit, berry fruit, vines, strawberries, hops, field crops, vegetables, tobacco, beet, pineapples, peanuts, ornamental and flower crops, tree nurseries, etc. Also has secondary insecticidal and fungicidal activity.[1]

[i] APPLICATION — Applied annually in either the spring or fall. May be used as a broadcast or row treatment. Application equipment should ensure placement of the product at least 15-20 cm below the final soil surface. Immediately after application, compact soil to limit fumigant loss.

[ii] RATES — 60-228 kg a.i./ha.

CARRIER: Not identified.

[iii] FORMULATIONS

1. LI

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 27.2 m
2. Air blast application: Calculated: (38.4) 28.8 m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store in tightly closed container, in a cool place away from dwellings. Do not contaminate food, feedstocks, or domestic water supplies. Do not ship or store with food, feeds, drugs or clothing. Stable under normal conditions.[1]

4. HANDLING PRECAUTIONS

Do not spill or empty into any stream, lake or other body of water. Has the potential, through agricultural use, to reach groundwater. Therefore, do not use in areas with highly permeable soil, where groundwater is near the surface, or of Karst topography

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Non-persistent in soils, undergoing hydrolysis to the corresponding 3-chloroallyl alcohols.[1] High mobility in soils.[2]

[ii] AQUATIC- If released into water, 1,3-dichloropropene is not expected to adsorb to suspended solids and sediment based upon the K_{oc}s.[2]

[iii] ATMOSPHERIC – If released to air 1,3-dichloropropene will exist solely as a vapor in the ambient atmosphere. Vapor-phase 1,3-dichloropropene will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 2 days. 1,3-Dichloropropene reacts with sunlight in the presence of free hydroxyl radicals with an estimated photolysis half-life of 7 to 12 hrs.[2]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1200 mg/kg		1
Rat	NOEL 90d inhalation	.05 mg/L		1
Bluegill sunfish	LC_{50} 96h	7.1 mg/L		1
Rainbow trout	LC_{50} 96h	3.9 mg/L		1
Daphnia	EC_{50} *48h*	*6.2 mg/L*		*1*

[i] TOXICITY (OTHER) — Severely irritating to skin, eyes and mucous membranes. Prolonged contact with skin can cause severe burns. Initially toxic to earthworms; not persistent, therefore re-colonisation is very quick.[1]

[ii] PHYTOTOXICITY — Phytotoxic, and should therefore not be applied near desired plants.

7. METABOLISM

[i] ANIMAL – Excretion in rats occurred primarily as the mercapturic acid conjugate and its corresponding sulfoxide. In plants, metabolism is rapid, progressing through 3-chloroallyl alcohol, 3-chloroacrylic acid and 3-chloro-1-proponal, leading ultimately to normal plant constituents. Metabolic half-life of 1.5 hours for 1,3-D and 4.4 hours for 3-CAA was calculated.[1]

[ii] PLANT – Metabolism is rapid leading ultimately to normal plant constituents.[1]

8. ADDITIONAL INFORMATION

Provincial restrictions exist on the use of 1,3-dichloropropene in Prince Edward Island. It is still in use in Nova Scotia, and potentially in use in New Brunswick.

9. REFERENCES

1. PM
2. HSDB

Dichlorprop

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dichlorprop (BSI, E-ISO, F-ISO, WSSA); 2,4-DP (former exception USSR)

[ii] TRADE NAME — Weedaway (Interprovincial Co-op Ltd.); Desormone, Nufarm (Nufarm Agriculture); Clean Crop (United Agri Products). *Propaturf (Rhone-Poulenc Canada Inc.)*

[iii] CHEMICAL NAME — (*RS*)-2-(2,4-dichlorophenoxy) propanoic acid.

[iv] CAS # — 53404-31-2

[v] TYPE / MODE OF ACTION— Post-emergence translocated herbicide

2. USE PATTERN

Systemic herbicide for brush control on rangeland, rights of way, and aquatic weeds. Control of *Polygonum* spp., *Galium aparine*, and chickweed in cereals. Used alone or mixed with other growth regulators or herbicides. At very low rates it prevents premature drop of apples.

[i] APPLICATION — Post-emergence herbicide. Used alone or in combination with other herbicides (*e.g.*, 2,4-D, MCPA, mecoprop, etc. in this region).

[ii] RATES — 0.5-2.7 kg a.i./ha; 3.0-4.0 kg a.i./1000L water; 0.8-1.1 kg a.i./100L fuel oil (basal stem treatment)

CARRIER: Water, fuel oil.

[iii] FORMULATIONS

1. EC and SN are the only formulation available in Canada.
2. Aqueous solution of potassium or amine salt.
3. Isoctyl and butyl esters.
4. Dichlorprop with MCPA combines as isoctylester or as potassium solution.
5. Also used mixed with 2,4-D or other herbicides.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

Acid stable to heat and resistant to reduction, hydrolysis, and atmospheric oxidation. Unstable in and imcompatible with alkaline media.[1] Salt formulations compatible with similar formulations of other growth-active herbicides. Acid corrosive to metals in presence of water but concentrated solutions do not corrode iron or tin plate at pH = 8.6 and temperature <70°. The acid is very stable, and forms sparingly-soluble, slightly-active salts with heavy metals.[1]

4. HANDLING PRECAUTIONS

Avoid spray drift to susceptible broadleaf plants (*e.g.*, tomatoes, soybeans, cotton). If stored below freezing, it may be necessary to warm to 4°C and agitate before using.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Phenoxy herbicides in forest and agricultural soils are subject to volatilization, adsorption, leaching, uptake by plants, and various chemical and biological degradation processes.[4] Average half-life in prairie soil is 10 days.[5] Due to the high rate of metabolic breakdown, traces of dichlorprop in leachate are very low.[1]

[ii] AQUATIC – Dichloroprop will have a low potential to adsorb from the water column to sediments and suspended material.[6]

[iii] ATMOSPHERIC – Dichloroprop will exist in the vapor and particulate phases in the ambient atmosphere. It will degrade in the vapor phase by reaction with photochemically produced hydroxyl radicals with an estimated half-life of about 12 hrs. Physical removal from air by dry deposition will also occur.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	825-1470 mg/kg		1
Rat	90 days	50.0 mg/kg/d	Slight liver hypertrophy	3
Rat	NOEL 2y	3.6-4.2 mg/kg/d		1
Mouse	LD_{50}	400 mg/kg	Acute oral	3
Mouse	LD_{50} dermal	1400 mg/kg		1
Mouse	LD_{50} oral	400 mg/kg		1
Mouse	LD_{50} dermal	1400 mg/kg		1
Japanese quail	LD_{50}	504 mg/kg		1
Rainbow trout	LC_{50} 96h	521 mg/L		1
Bluegill	LC_{50} 48h	165 mg/L	Dichlorprop-dimethylammonium	2
Bluegill	LC_{50} 48h	16.0 mg/L	Dichlorprop-isoctyl	1
Bluegill	LC_{50} 48h	1.1 mg/L	Dichlorprop-butotyl	1

[i] TOXICITY (OTHER) — 2.4 solution did not irritate skin in mice. 1% solution did not irritate eyes in mice.[3] Not toxic to bees.[1]

[ii] PHYTOTOXICITY- Not identified.

7. METABOLISM

[i] ANIMAL – Dichlorprop is absorbed and excreted essentially unchanged.[1]

[ii] PLANT – Dichlorprop is metabolized in a similar manner to that in soil.[1]

8. ADDITIONAL INFORMATION

Commercial product contains equal amounts of 2 optical isomers; only the dextro isomer is biologically active. More selective than 2,4-D.

9. REFERENCES

1. PM
2. FCH
3. HH
4. Norris, L.A. (1981) The movement, persistence and fate of the phenoxy herbicides and TCDD in the forest. *Residue Reviews*, 80: 66-135.
5. Smith, A.E. (1978) Relative persistence of di- and tri-chlorophenoxy alkanoic acid herbicides in Saskatchewan soils. *Weed Res.* 18: 275.
6. HSDB

Dichlorvos

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dichlorvos (BSI, E-ISO, F-ISO, BAN, ESA); DDVP (JMAF); dichlorfos (USSR); DDVF (former exception USSR)

[ii] TRADE NAME — Disvap (Dispar Division of Vetoquinol N.-A.); DDVP (United Agri Products) *Vapona (Ciba Geigy Canada Ltd.); Riddex (Kemsan Inc.)* . Other names include *Gardex*, Nuvan, Apavap and Vaporette.

[iii] CHEMICAL NAME — 2,2-dichlorovinyl dimethyl phosphate

[iv] CAS # — 62-73-7

[v] TYPE / MODE OF ACTION— Organophosphorus compound (Dialkyl vinyl phosphate[7]) with contact and stomach action. Acts as a fumigant, insecticide, and acaricide. Cholinesterase inhibitor. Unlike most organophosphorus insecticides, produces insecticidal concentration of vapour.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Control of insect pests in public health, in homes, warehouses, food stores and transport, and in stored grain. Controls insects on domestic animals. Control of mushroom flies, aphids, spider mites, caterpillars, thrips, and white flies in greenhouse crops and field fruits and vegetables.

[i] APPLICATION — LIVESTOCK (Bait): Apply with brush to faces of animals daily for 2 weeks and as needed thereafter. (Spray): Apply daily, do not wet hair. PREMISES: Spray; fog; dry bait for housefly insecticidal strips; aerosol.

[ii] RATES — LIVESTOCK, (bait): 0.05% concentration in corn syrup bait; (spray): 28.0-56.0 mL of 1% solution per animal per day. FIELD, 300-1000 g/ ha for crop protection against sucking and chewing insects. 0.59 g a.i./strip. 0.5-1.0 g a.i./100 m^3 for protection of stored products. FOG, Mushroom houses, 1.0 mL a.i./ 100 m^3 of space. Tobacco warehouses, 35.0-70.0 mL a.i./ 1000m^3 of space.[4]

CARRIER: Water.

[iii] FORMULATIONS

1. SN
2. SR
3. EC
4. SO
5. GR as baits, resin strips, flea collars, sprays, and aerosols.

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 49-57 m
2.	Air blast application:	Calculated: 51(61)-60(70) m
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Stable to heat; hydrolyzed in water or alkaline solutions. Corrosive to iron and steel. Incompatible with alkaline materials, chinomethionat, and dichloflanid.[1]

4. HANDLING PRECAUTIONS

Do not contaminate food, feed, or water. Do not combine with alkaline materials.

5. ENVIRONMENTAL PERSISTENCE

Non-persistent, undergoes rapid decomposition in the atmosphere.

[i] SOIL — Subject to hydrolysis and biodegradation with a half-life of 7 days.[6] Breakdown is rapid in alkaline soils and water, but is slow in acidic media.[6]

[ii] AQUATIC — Degrades by hydrolysis (Half-life ~4 days in lakes and rivers).[6] Half-life varies considerably with pH.[5] Biodegradation and volatilization may be minor fate processes.

[iii] ATMOSPHERIC — Expected to react with hydroxyl radicals (Half-life ~2 days) and ozone (Half-life ~320 days).[5]

[iv] PHYTODEGRADATION — Not identified.

[v] OTHER — Not identified.

6. TOXICITY

Animal	*Time*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	50.0 mg/kg		2
Rat	LD_{50} dermal	300 mg/kg		1
Rat	LC_{50} inhalation 4h	0.1 mg/L air		1
Rat	NOEL 2y	10.0 mg/kg diet		1
Mouse	LD_{50} oral	61.0-175 mg/kg		6
Rabbit	LD_{50} dermal	107 mg/kg		6
Dog	LD_{50} oral	100-1090 mg/kg		6
Human	ADI	0.004 mg/kg	Estimated	7
Human		0.033 mg/kg	Caused toxicologically insignificant depression of plasma ChE activity	7
Japanese quail	LD_{50} oral	26.8 mg/kg		1
Rainbow trout	LC_{50} 96h	0.93 mg/L		1
Cutthroat trout	LC_{50} 96h	0.17 mg/L		5
Bluegill	LC_{50} 24h	1.0 mg/L		2
Fathead minnow	LC_{50} 96h	11.6 mg/L		6
Mosquito fish	LC_{50} 96h	5.3 mg/L		6
Striped killifish	LC_{50} 96h	2.3 ppm	Static bioassay	5
Stonefly	LC_{50} 96h	0.1 ug/L		5
Gammarus lacustris	*LC_{50} 96h*	*0.5 ug/L*	*Static bioassay*	*5*
Gammarus fasciatus	*LC_{50} 96h*	*0.4 ug/L*		*5*
Daphnia	*EC_{50} 48h*	*0.19 ug/L*		*1*

[i] TOXICITY (OTHER) — ChE inhibitor; poisonous if swallowed, inhaled, or absorbed through skin. No clear-cut evidence of carcinogenicity in rodents for dichlorvos or metabolites.[8] Highly toxic to bees. Toxic to birds and fish. No evidence that dichlorvos affects reproduction or is teratogenic.; no evidence of metagenicity has been found in tests performed on live animals.[6]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed, except to some varities of chrysanthemum.[1]

7. METABOLISM

[i] ANIMAL – Rapidly metabolized in mammalian tissues to relatively non-toxic metabolites which are rapidly excreted.[7] In domestic animals, rapidly detoxified and degraded; unlikely to produce significant residues in meat, milk, or eggs.[7]

[ii] PLANT – Rapidly decomposed in plants.[1]

8. ADDITIONAL INFORMATION

Levels of residues in raw agricultural commodities are low, and residue levels decline rapidly. Any deposit absorbed into plant tissue undergoes hydrolysis to inactive metabolites. Use of impregnated strips in buildings gives rise to detectable residues in stored and prepared foods. Residues resulting from exposure to levels much higher than recommended have been shown to decrease very rapidly on exposure to atmosphere. Also readily destroyed by washing and cooking. This active ingredient has received trial use in fin fish aquaculture for sea lice control.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. PP
7. Green, M.B., G.S. Hartley and T.F. West (1977) *Chemicals for Crop Protection and Pest Control*. Pergamon Press: Oxford, New York, Toronto. 290 pp.
8. Ramel, C., J. Drake and T. Sugimura (1980) An evaluation of the genetic toxicity of dichlorvos. *Mutat. Res*. 76: 297-309.

Diclofop-methyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — diclofop-methyl

[ii] TRADE NAME — Hoe-Grass (AgrEvo Canada Inc.)

[iii] CHEMICAL NAME — (*RS*)-2-[4-(2,4-dichlorophenoxy)phenoxy]-methyl-propionic acid

[iv] CAS # — 51338-27-3

[v] TYPE / MODE OF ACTION— A selective diphenyl compound used as a contact and translocated pre-emergence and post-emergence grass herbicide.

2. USE PATTERN

Herbicide for the control of annual grass weeds. The margin of selectivity is so great that formulations can be used post-emergent.

[i] APPLICATION — PRE-EMERGENCE: Applied prior to crop emergence. POST-EMERGENCE: Applied when grasses are in the 1-4 leaf stage. The larger the grasses, the higher the rate required. Grasses should be growing actively at the time of application. May be applied by air. Do not apply if rain is expected within 1 hour after application.[4] May be applied with a crop oil concentrate.

[ii] RATES — Applied at 0.7-1.4 kg a.i./ha

CARRIER: Oil concentrate.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 6 m
2. Air blast application: Not identified.
3. Aerial application: Claculated: 15 m
4. Forestry application: Not identified.

3. STORAGE

Stable to light.[1] Decomposed by UV irradiation, and by strong acids and alkalis.[7] Store where contamination of fertilizer, seed, and foodstuffs will not occur.[7]

4. HANDLING PRECAUTIONS

Avoid contact with eyes, skin, or clothing. Wear goggles, rubber gloves, hat, impermeable pants and shirts, and waterproof boots. [7] Do not take internally. Do not graze treated areas. An interval of 8-10 days must be maintained between the application of this compound and the application of phenoxy or dinitro based herbicides.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – In plants and soil, it is rapidly decomposed to diclofop, which is then degraded further. Low levels of leaching.[1] Not persistent in soil under aerobic conditions and very low persistence in anaerobic soil or water.[6]

[ii] AQUATIC – If released to water, dichlorfop-methyl will be essentially non-volatile. Dichlorfop-methyl has aqueous base-catalyzed half-lives of 6.3 days at pH 9, 63 days at pH of 8, and 1.7 years at pH of 7. Dichlorfop-methyl will undergo moderate bioconcentration in aquatic organisms and adsorption to sediment will be possible due to high K_{oc} values. [7]

[iii] ATMOSPHERIC – If released to the atmosphere, dichlorfop-methyl will exist in the vapor and particulate phases. In the vapor phase, it will degrade in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of 21 hours. Physical removal from air can occur through wet and dry deposition.[7]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	481-693 mg/kg		1
Albino rat	LD$_{50}$ oral	580 mg/kg	Technical grade	3
Rat	NOEL 2y	0.1 mg/kg b.w.		1
Wood mouse	40 wk. F.T.	200 mg/kg	Some liver damage and necrosis	5
Wood mouse	2 wk. F.T.	1000 mg/kg (2 1/2 times the field rate)	Extensive liver damage producing symptoms of chronic hepatitis	5
Dog	NOEL 15 mo.	0.44 mg/kg b.w.		1
Quail	LC$_{50}$ dietary 8d	>20000 mg/kg		2
Rainbow trout	LC$_{50}$ 96h	0.23 mg/L		1
Daphnia	*EC$_{50}$ 48h*	*0.23 mg/L*		*1*

[i] TOXICITY (OTHER) — Toxic to fish (toxicity to fish of technical material is not measurable due to insolubility of material in water). Non-toxic to bees. Not irritating to skin.[7] This compound is not a hazard to small wild animals when used at recommended rates.[5] Poses a risk of reproductive toxicity to mammals.[6] Possibly carcinogenic.[7]

[ii] PHYTOTOXICITY – Phytotoxic to maize, sorghum, oast, sugar cane, rice and cotton.[1]

7. METABOLISM

[i] ANIMAL – When fed to rats, diclofop-methyl is almost totally absorbed and then rapidly excreted in the urine and faeces (approximately 90% is recoved unchanged in the faeces and urine after 2 days and 99% after 7 days). Accumulation of residues in the body is unlikely. Metabolites are identicial with those in plants.[1]

[ii] PLANT – Taken up rapidly and almost completely by plants, with little translocation; hydrolysed relatively quickly.[1]

8. ADDITIONAL INFORMATION

Effective on annual grass species only. Perennial grasses not controlled. No effects have been observed on broadleaves. Symptoms on grasses do not show for several days following application. Pre-plant soil incorporated treatments are being investigated. Almost all dicots are tolerant except cotton. Moisture must be present for the best results. Tank mixtures with other herbicides must not be used as diclofop-methyl is incompatible with most other herbicides.[1]

9. REFERENCES

1. PM
2. FCH
3. AC
4. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control*. Atlantic Supplement Edition. 101 pp.
5. Westlake, G.E., K.A. Tarrant and R.R. Hardy (1988) Biochemical and histological effects of diclofop-methyl in mice and voles under laboratory conditions. *Bull. Environ. Contam. Toxicol.* 40: 153-158.
6. USEPA. 2000. R.E.D. Facts: Diclofop-methyl. Prevention, Pesticides and Toxic Substances. EPA-738-F-00-007, September.
7. HSDB

Dicofol

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dicofol (BSI, E-ISO, F-ISO, ESA); kelthane (JMAF); exception (FRG)

[ii] TRADE NAME — Kelthane (Rohm and Haas Canada Inc); Isotax (Chevron Chemicals (Canada) Ltd)

[iii] CHEMICAL NAME — 2,2,2-trichloro-1,1-bis (4-chlorophenyl)ethanol

[iv] CAS # — 115-32-2

[v] TYPE / MODE OF ACTION — Non-systemic contact acaricide; chlorinated hydrocarbon structurally related to DDT.

2. USE PATTERN

Currently used on many fruit, vegetables, ornamental and field crops, dwellings, outdoor surfaces, and buildings for control of various species of mites, especially those resistant to OP compounds. No insecticidal activity.

[i] APPLICATION — Apply thoroughly, covering undersides of leaves. Apply when mites first appear in threatening numbers and repeat as necessary. Mix wettable powder with water and spray.

[ii] RATES — Applied at 0.3-3.9 kg a.i./ha in 1000 L water. Also recommended at 0.5-2.0 kg a.i./ha.[1]

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. WP
3. SN

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 16-25 m
2.	Air blast application:	Calculated: 16(26)-26(35) m
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Hydrolyzed by alkali. Incompatible with highly alkaline materials. WP formulations are sensitive to solvents and surfactants, which may affect acaricidal activity and photoxicity.[1] Store away from feed, foodstuffs or any body of water.[8]

4. HANDLING PRECAUTIONS

Do not feed crop residues to dairy or slaughter animals. Do not mix with alkaline materials. Gloves for mixing, loading or applying. Self-contained breathing apparatus if exposed to vapours; rubber gloves; boots; splash goggles.[8] Avoid skin contact, inhalation of mist. Wash thoroughly after use. Harmful if swallowed.[8]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Moderately persistent in soil, with a half-life of 60 days.[6] Practically insoluble in water and absorbs very strongly to soil particles. Although residues in soil decrease rapidly, traces may remain for roughly 1 year. No mobility of parent or metabolites detected. Susceptible to chemical breakdown in moist soils and to degradation by UV light.[6] Dichlorobenzophenone is a major degradate in all processes[1]

[ii] AQUATIC – Unlikely to infiltrate groundwater.[6] Possible for difocol to enter surface waters when soil erosion occurs. Degrades in water, expected to absorb to sediment when released into open waters.[6]

[iii] ATMOSPHERIC – If released to air dicofol will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase dicofol will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 4.7 days. Particulate-phase dicofol will be removed from the atmosphere by wet and dry deposition.[8]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	820-960 mg/kg		2
Rabbit	LD_{50} dermal	>2500 mg/kg		1
Dog	NOEL 1y F.T.	30.0 mg/kg diet		1
Human	ADI	0.002 mg/kg		1
Mallard	LC_{50} 5d	1651 ppm		1
Rainbow trout	LC_{50} 24h	0.12 mg/L		1
Fathead minnow	LC_{50} 96h	0.183 mg/L		1
Grass shrimp	LC_{50} 24h	777-2138 nl/L		3
Grass shrimp	LC_{50} 48h	437-832 nl/L		3
Grass shrimp	Lethal threshold concentration	Approx. 100 nl/L		3
Daphnia	*EC_{50} 48h*	*0.14 mg/L*		*1*

[i] TOXICITY (OTHER) — Toxic to fish, aquatic invertebrates and algae; highly toxic to bees.[4] Slightly toxic to birds.[6] Non-teratogenic, Non-mutagenic.[6] Reproductive effects in avia, mammalian species, fish and aquatic invertebrates.[7]

[ii] PHYTOTOXICITY — Injury has occurred on eggplants and pears. Do not use on canaeti juniper or Chinese holly. Non-phytotoxic when used as directed, but aubergines and pears may be injured.[1]

7. METABOLISM

[i] ANIMAL — Storage occurs in animal fat.[5] Dichlorobenzo-phenone is a probable metabolite.[5]

[ii] PLANT – Difocol residues on treated plant tissues have been shown to remain unchanged for up to 2 years.[6]

8. ADDITIONAL INFORMATION

Good initial kill and long residual action. Does not harm beneficial insects. Compatible with other commonly used pesticides, except alkaline materials. WP formulations sensitive to solvents and surfactants; these may affect acaricidal activity and phytotoxicity.

9. REFERENCES

1. PM
2. FCH
3. Khorram, S. and A.W. Knight (1977) The toxicity of kelthane to the grass shrimp (*Crangon franciscorum*). *Bull. Environ. Contam. Toxicol.* 18: 674-682.
4. Ontario Ministry of the Environment (1978) Pesticides Safety Handbook. 50 pp.
5. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out bu the Joint FAO/WHO Expert Committee on Pesticide Residues. 1. Organohalogenated pesticides used in agriculture and public health. *Residue Reviews*, 56: 107-134.
6. PP
7. USEPA. 1998. R.E.D. Facts: Dicofol. Prevention, Pesticides and Toxic Substances. EPA-738-F-98-016, November.
8. HSDB

Didecyl dimethyl ammonium chloride

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — didecyl dimethyl ammonium chloride

[ii] TRADE NAME — Bardac (Lonza Inc.); Vestal (Calgon Vestal Labs Inc.); Coverage (Convatec); Quinticare (Schroer Manufacturing Co.); Econocide; *QC 2 (Napier Int's Technologies Inc.).*

[iii] CHEMICAL NAME — *N*-Decyl-*N*,*N*-dimethyl-1-decanaminium chloride

[iv] CAS # — 7173-51-5

[v] TYPE / MODE OF ACTION — Quaternary ammonium compound used as a fungicide and disinfectant.

2. USE PATTERN

[i] APPLICATION — Used in antisapstains to control mold growth in lumber. Effective on both softwood and hardwood species. Treat lumber via spray or dip-tank immediately after it is sawn. Also used to disinfect agricultural equipment and animal kennels.[1]

[ii] RATES — Antisapstains, 646 mL a.i./10-15 L water. Poultry equipment, 0.06 mL a.i./ L water.[1]

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. SN
3. MS

[iv] SUGGESTED AQUATIC SET BACKS

4. Ground application: Not identified.
5. Air blast application: Not identified.
6. Aerial application: Not identified.
7. Forestry application: Not identified.

3. STORAGE

Corrosive. Do not store near heat or open flames. Do not mix with soap or anionic chemicals.[1]

4. HANDLING PRECAUTIONS

Do not get in eyes, on skin or clothing. Protect eyes and skin when handling. Avoid contamination of food. Harmful if swallowed. Aviod breathing spray mist. Wear chemical resistant gloves, long sleeve shirt and long pants while handling the concentrate. GREENHOUSE: Wear chemical resistant overalls with elastic face hood, designed to accommodate full-face respirator, chemical resistant gloves, and a full face with approved organic-vapour-removing cartridge with prefilter. Do not allow greenhouse workers to enter area during treatment. Ventilate prior to entry. Do not re-enter treated areas for 48 hours.[1] Do not flush liquid wastes into streams or other surface water.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Corrosive.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rainbow trout	LC_{50} 96h	0.41 ppm	Juveniles	3
Rainbow trout	LC_{50} 96h	0.409 mg/L	Flow-through conditions	6
Fathead minnow	LC_{50} 96h	0.33 ppm	Flow-through conditions	3
Fathead minnow	LC_{50} 24h	0.47 mg/L	Neonates (<24h)	2
Coho salmon	LC_{50} 24h	1.0 mg/L	Juveniles, static bioassay	4
Coho salmon	LC_{50} 24h	0.84 mg/L		5
Coho salmon	LC_{50} 96h	0.95 ppm	Smolt	3
Hyalella azteca	*LC_{50} 48h*	*0.11 ppm*	*Adults and juveniles, static bioassay*	*3*
Daphnia magna	*LC_{50} 48h*	*0.037 ppm*	*Static bioassay*	*3*

[i] TOXICITY (OTHER) — Toxic to fish, wildlife, and domestic animals. Causes eye damage and skin irritation.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

Not identified.

9. REFERENCES

1. PMRA
2. Bargar, T.A. and S.W. Fisher. 1997. Molluscicide acute and sub-chronic toxicity to the three non-target species *Hexagenia limbata, Ceriodaphnia dubia,* and *Pimephelas promelas*, and the neutralization of that toxicity by bentonite clay. *Bull. Environ. Contam. Toxicol.* 58: 275-282.
3. Farrell, A.P., G.J. Kennedy, A. Wood, R.D. Johnston, and W.R. Bennett. 1998. Acute toxicity of a didecyldimethylammonium chloride-based wood preservative, Bardac 2280, to aquatic species. *Environ. Toxicol. Chem.* 17(8): 1552-1557.
4. Henderson, N.D. 1992. A review of the environmental impact and toxic effects of DDAC. British Columbia Ministry of Environment, Victoria, B.C., Canada.
5. Johnston, B.D., J.M. Seubert, and C.J. Kennedy. 1998. Biochemical effects of didecyldimethylammonium chloride (DDAC) exposure and osmoregulatory stress on juvenile coho salmon, *Oncorhynchus kisutch*. Arch. Environ. *Contam. Toxicol.* 34(3): 275-279.
6. Wood, A.W., B.D. Johnston, A.P. Farrell, and C.J. Kennedy. 1996. Effects of didecyldimethylammonium chloride (DDAC) on the swimming performance, gill morphology, disease resistance, and biochemistry of rainbow trout (*Oncorhynchus mykiss*). *Can. J. Fish. Aquat. Sci.* 53(11): 2424-2432.

Dienochlor

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dienochlor (BSI, E-ISO); dienochlore (F-ISO)

[ii] TRADE NAME — Pentac (Syngenta Crop Protection Canada Inc.); Myten

[iii] CHEMICAL NAME — perchloro-1,1'-bicyclopenta-2,4-diene

[iv] CAS # — 2227-17-0

[v] TYPE / MODE OF ACTION— A chlorinated hydrocarbon acaricide. Acts by interference with oviposition.[1]

2. USE PATTERN

This specific acaricide is very effective against most plant-damaging mites including the two-spotted spider mite, lumid spider mite, strawberry spider mite, spruce spider mite, citrus red mite, European red mite, and others. For use on glasshouse roses and other ornamentals. Do not apply to edible crops.

[i] APPLICATION — Apply uniformly with common application equipment. Apply before mites attain destructive numbers and repeat as necessary.[3] On glasshouse roses use 2 applications, 14 days apart. On other ornamentals one application is sufficient, except for severe attacks.

[ii] RATES — Solution: 24.7 mL a.i. in 100 L water for greenhouse as spray; 456 mL a.i./ha for outdoor use; 0.285mL a.i. in 1L water for interior use. Wettable powder: 62.0 g/100 L water treats 400-600 mature bushes.

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. WP
3. SN

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Not identified.
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Stable for a minimum of 2 years with normal storage.[2] Store in original container, in a dry place and keep from freezing. Keep separate from phosphites and strong reducing agents.

4. HANDLING PRECAUTIONS

Causes moderate eye irritation. Avoid contact with eyes and avoid inhalation of spray mist.

5. ENVIRONMENTAL PERSISTENCE

Dienochlor has a long residual activity. It is decomposed by direct sunlight or at temperatures >130°C. [4] Stable in acidic and alkaline media.[4]

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg	Males and females	1
Rabbit	LD_{50} dermal	>3160 mg/kg		1
Rabbit	Single eye application	3.0 mg	Slight irritation which subsided by the 6th day	4
Bobwhite quail	LD_{50} oral	4319 mg/kg		1
Rainbow trout	LC_{50} 96h	1.8-2.1 mg/L		1
Daphnia	*EC_{50} 48h*	*1.2 mg/L*		*1*

[i] TOXICITY (OTHER) — Neither a primary irritant nor a sensitizer to human skin.[2] Toxic to fish and other aquatic organisms. No insecticidal activity.[3] Non-toxic to bees.[5]

[ii] PHYTOTOXICITY – Not phytotoxic when used as directed.[1] Very low phototoxicty of formulations.[2]

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

Slow acting, therefore dienochlor should be used in a preventative program or in combination with a knockdown agent.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
5. PP

Difenzoquat

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — difenzoquat (BSI, E-ISO, F-ISO, ANSI, WSSA)

[ii] TRADE NAME — Avenge (Cyanamid Canada Inc.)

[iii] CHEMICAL NAME — 1,2-dimethyl-3,5-diphenylpyrazolium

[iv] CAS # — 43222-48-6

[v] TYPE / MODE OF ACTION— A pyrazolium compound used as a selective post-emergence herbicide. Controls by contact only.[2]

2. USE PATTERN

For control of wild oats, *Avena fatua, A. Sterilis,* and *A. sterilis* ssp *ludoviciana* in wheat, barley, flax, and rape.

[i] APPLICATION — Apply post-emergence when the wild oats are in the 3-4 leaf stage. It is effective at the 4-5 leaf stage, but application at this time may reduce crop yield. No pre-emergence activity has been noted.[2] May be applied by ground equipment or aircraft. Rain within 4 hours of application may result in erratic control. Surfactant required

[ii] RATES — AERIAL: 554-840 g a.i./ 0.67-1.0 ha in 100-400 L water. GROUND: 554-840 g a.i./3.33-7.9 ha in 320-800 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. SN
2. SP
3. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

The aqueous solution may attack tin, zinc and aluminum but does not attack 316 stainless steel. It is stable for a minimum of 24 months at 25°C, but will crystalize at 5°C or below. Stable in weakly acidic media, but decomposed by strong acids and oxidants.[1] The solid technical formulation is stable indefinitely and can be stored at 50°C or above.[3] Unstable in alkaline solutions.[3]

4. HANDLING PRECAUTIONS

When handling wear goggles & gloves. Avoid contact with eyes, skin, or clothing as this product penetrates skin rapidly. Do not contaminate food or feed. If handled indoors, provide mechanical exhaust ventilation.

5. ENVIRONMENTAL PERSISTENCE.

Non-volatile. Readily demethylated photolytically to monomethyl pyrazole.[1]

[i] SOIL — Residues in the soil disappear at a moderate rate and rotation to other crops can be made the following year. It is not significantly metabolized by microorganisms.[3] Negligible mobility due too strong adsorption to clay.[3]

[ii] AQUATIC — Does not persist in aquatic environments.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	470 mg/kg		1
Rat	LC_{50} inhalation	>410.5 mg/L air		
Rat	NOEL 2y F.T.	500 mg/kg	No ill-effects	1
Mouse	LD_{50}	31.0 mg/kg	Males	1
Rabbit	LD_{50} dermal	3540 mg/kg		1
Bobwhite quail	LC_{50} dietary 8d	>4640 mg/kg diet		1
Mallard	LC_{50} dietary 8d	10,388 mg/kg diet		1
Bluegill	LC_{50} 96h	696 mg/L		1
Rainbow trout	LC_{50} 96h	694 mg/L		1

[i] TOXICITY (OTHER) — Low order of toxicity to mallard duck, bobwhite quail, and honeybees. It does not bioaccumulate in fish and is relatively non-toxic.[3] Proven animal carcinogenic, may be both mutagenic and teratogenic.[4]

[ii] PHYTOTOXICITY — Not identified.

7. METABOLISM

[i] ANIMAL - Not identified.

[ii] PLANT - Difenzoquat rapidly penetrates the foliage. It is not significantly metabolized by plants because it inherently possesses ionic character, a property common to most metabolites. However, it is readily demethylated photolytically to the volatile monomethyl pyrazole. Residues of difenzoquat at harvest in grains are below the validated sensitivity level of 0.05 mg/L.[3]

8. ADDITIONAL INFORMATION

Not to be mixed with any formulation containing MCPA amine, 2,4-D amine, dicamba, or Target as crop injury or reduced weed control may result.

9. REFERENCES

1. PM
2. AC
3. HH
4. HSDB

Diflubenzuron

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — diflubenzuron (BSI, E-ISO, F-ISO, ANSI, ESA)

[ii] TRADE NAME — Dimilin (Duphar B.V., T.H. Agriculture and Nutrition Co.Inc., Uniroyal Chemical Co.)

[iii] CHEMICAL NAME — 1-(4-chlorophenyl)-3-(2,6-difluorobenzoyl)urea

[iv] CAS # — 35367-38-5

[v] TYPE / MODE OF ACTION— Chlorinated diphenyl compound used as an insect growth regulator and insecticide. Effective as a stomach and contact poison, acting by inhibition of chitin synthesis thereby interfering with cuticle formation. Therefore, all stages of insects that form new cuticles should be susceptible.[17] Diflubenzuron also acts as a sterilant.[12] It has no systemic activity and does not penetrate plant tissue hence sucking insects are generally unaffected.[17]

2. USE PATTERN

For use against many insect predators and parasites such as leaf-feeding larvae and leaf miners in forestry, top fruit, field crops and horticultural crops. Also controls Sciaridae and Phoridae larvae in mushrooms, mosquito larvae in temporary ponds, Gypsy moth, and fly (*Stomoxys calcifrans, Musca domestica*) larvae in animal housings.[1] May be fed to livestock to control flies in manure.

[i] APPLICATION — Applied when insects first appear in the larval stage. Thorough coverage is necessary. The best application time is during the second and third instar of the larval stage.[3] Aerial or ground spray or mist blower to water or vegetation surfaces.

[ii] RATES — As a water application, 20.0-48.0 g a.i./ha water surface. As a treatment in animal housings, 0.5-1.0 g a.i./m^2 surface. FOREST APPLICATIONS: 37.5-68.75 g a.i./ha.

CARRIER: Water.

[iii] FORMULATIONS

1. WP

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 0 m
2.	Air blast application:	Calculated: 0 m
3.	Aerial application:	Calculated: 0 m
4.	Forestry application:	Not identified.

3. STORAGE

STABILITY — <0.5% decomposition after 1-day storage at 100°C, and <0.5% decomposition after 7-day storage at 50°C. In aqueous solution (20°C), stable at pH 5 and 7.[1] Light-sensitive when in solution, but stable to sunlight as a solid.[1] Incompatible with strongly alkaline products[1]

4. HANDLING PRECAUTIONS

Keep out of reach of children. Harmful if swallowed. Avoid contact with eyes, skin and clothing.[20]

5. ENVIRONMENTAL PERSISTENCE

In its solid form, diflubenzuron is stable to sunlight.[1]

[i] SOIL — Rapidly degraded in soil (50% degradation in <7 days).[1,15] The major metabolite (4-chlorophenyl urea) has been found in oil only, after spraying, and at low levels (>0.05 mg/L).[17] Soil microorganisms appear to play an important role in this decomposition. After 4 weeks in natural sandy loam soil only 2% diflubenzuron remained; in sterilized sandy loam soil 94% remained.[6] Degradation is more rapid in hot, wet than in cool, dry conditions.[12] Because of its rapid degradation in soil, groundwater contamination by diflubenzuron through leaching is unlikely.[4]

[ii] AQUATIC — Decomposition of diflubenzuron at 20°C in aqueous solution after 21 days in the dark is: 4% at pH 5.8, 8% at pH 7, 26% at pH 9. [17] Residual control of 3-10 days can be expected in water for mosquito larval control.[3]

[iii] ATMOSPHERIC- If released to air diflubenzuron will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase diflubenzuron will be removed from the atmosphere by wet and dry deposition.[19]

[iv] PHYTODEGRADATION — Very persistent on plant surfaces.[14] One study described levels remaining virtually constant on the surface of cotton leaves until rainfall, 14 days post-spray.[12] Persists on foliage until leaf fall and may be detected on the peel of harvested fruit,[5] especially in cool, dry climates.[12] When applied at 5.0 mg/L, diflubenzuron has a half-life of >23 mo. on stored wheat.[10] Dilution of diflubenzuron on alfalfa appears to be caused more rapidly by herbage growth than by chemical degradation.[8]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>4640 mg/kg		1
Rat	LD_{50} 14d	>400 mg/kg		12
Rat	NOEL 2y F.T.	40.0 mg/kg diet		1
Rat	Acute inhalation	>2.88 mg/L		4
Rat	3-generation	8.0 mg/kg/d	Highest tested dose No adverse effects on reproduction	4
Mouse	LD_{50} oral	>4640 mg/kg		1
Mouse	LD_{50} 14d	640 mg/kg		12
Mouse	LD_{50} acute intraperitoneal	>2150 mg/kg		1
Dog	NOEL 13 wk. F.T.	160 mg/kg diet		4
Sheep	NOEL 13 wk F.T.	10,000 mg/kg diet		4
Mallard	LC_{50} dietary 8d	>4640 mg/kg diet		1
Bobwhite quail	LC_{50} dietary 8d	>4640 mg/kg diet		1
Bluegill	LC_{50} 96h	135 mg/kg		1
Rainbow trout	LC_{50} 96h	140 mg/kg		1
Fathead minnow	NOEL 30d	36.0 mg/L	Juveniles, flow-through	11
Guppy	NOEL 96h	36.0 mg/L	4-wk. old, flow-through	11
Juga plicifera	*7 days*	*36.0 mg/L*	*No effects on survival, growth, or reproduction*	*11*

[i] TOXICITY (OTHER) — No effects observed in teratogenic, mutagenic and oncogenic studies in rats.[1] Low avian, fish and aquatic invertebrate toxicity[2] and relatively non-hazardous to predatory insects.[13] Non-toxic to honeybees, but it is detectable in honey made by bees in sprayed orchards.[7] It is toxic to shrimp and crabs,[3] and is a mild eye-irritant.[12] Does not appear to be teratogenic, mutagenic or carcinogenic.[18]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL — Metabolized slowly in insects, but more rapidly in mammals.[12] Although it does not cause overt necrosis of the mouse liver, it apparently may alter the way endogenous and exogenous compounds are metabolized by the liver.[16] At 250 mg/kg diet, residues can be found in milk, liver, and kidneys of cattle. The primary known metabolites are *p*-chlorophenylurea, *p*-chloroaniline, and 4-chloroocetanilide.

[ii] PLANT — There is very little translocation of diflubenzuron away from treated areas. Non-systemic. Not metabolized on plants.[1]

8. ADDITIONAL INFORMATION

High concentrations of diflubenzuron may retard the growth of nitrogen-fixing bacteria.[9]

9. REFERENCES

1. PM
2. FCH
3. AC
4. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
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16. Young, M.F., L.D. Trombetta and S. Carson (1986) Effects of diflubenzuron on the mouse liver. *J. Applied Toxicol.*, 6:343-348.
17. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
18. PP
19. HSDB
20. PMRA. Diflubenzuron Technical, Crompton Co.

Dimethoate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dimethoate (BSI, E-ISO, F-ISO, ANSI, ESA, JMAF); fosfamid (USSR)

[ii] TRADE NAME — Lagon (United Agri Products); Sys-tem (Zeneca Agro); Cygon (Ciba-Geigy Canada Ltd.); Apavap.

[iii] CHEMICAL NAME — *O,O*-dimethyl *S*-methylcarbamoylmethyl phosphorodithioate

[iv] CAS # — 60-51-5

[v] TYPE / MODE OF ACTION — Systemic organophosphorus (phosphorodithioate group) insecticide/arcaricide with contact and stomach action. Cholinesterase inhibitor.

[vi] NOTICE — **As of December 31, 2004 Canadian sale of domestic class dimethoate products will end. Commercial class dimethoate products are undergoing re-evaluation** in Canada. On March 31, 2002, the U.S. EPA followed a request from registrants and published a cancellation order and label amendments for dimethoate end-use products, for all residential and certain agricultural uses.

2. USE PATTERN

Used on a number of fruit and vegetable crops, ornamentals, shrubs, and trees to control a wide range of insects. Effective as residual spray for fly control in cowsheds, poultry and swine farms, agricultural processing plants, and buildings. Also used for fly control outside the home. Used to control fly maggots in manure piles. Dimethoate is effective in reducing infestation levels of the cone gall midge and the seed chalcid by 78% and 39%, respectively, when applied twice at 0.23% concentration per application.[10]

[i] APPLICATION — GRANULAR: To control grasshoppers on pasture and cereal crops. Place 13 cm away from row, 5 cm deep, at planting. Water immediately. Apply at uniform rate with common application equipment. Repeat as necessary. Residual wall spray for use on farm buildings. On 1-3 year old fruit trees, apply in furrow or basin around base of tree. Apply when insect injury to new growth appears.

[ii] RATES — Apple, pear, 0.48-0.72 kg a.i./ha in 1000 L water. Cereal crops, 0.2-0.41 kg a.i./ha. Potatoes, 0.26-0.53 kg a.i./ha. Ornamentals, 0.48-0.96 kg a.i./ 1000 L water. Farm buildings, 12.0 g a.i./L water. Outdoor use, 140-700 g a.i./ha.[4]

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. GR are registered in Canada.
3. Other formulations include SN and SO.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 9-15 m
2. Air blast application:	Calculated: 22(31)-29(39) m
3. Aerial application:	Calculated: 70-480 m
4. Forestry application:	Not identified.

3. STORAGE

Store between 4°C and 32°C. [4] Stability increases at pH values between 4 and 7. Stable in aqueous solution but heating converts it to the $-SCH_3$ isomer. Biological activity remains practically unvaried for 2 years under environmental conditions, provided it is stored in the unopened and undamaged original container in shaded, cool, well-aired places.[2]

4. HANDLING PRECAUTIONS

Incompatible with alkaline and sulfur-based materials. Repeated careless use may cause ChE inhibition. Use on agricultural premises only after animals have been removed. Do not get in eyes, on skin or clothing. Do not breathe dust. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling. Do not contaminate food or feed products. Liquid formulations must be stored above 7°C. Keep dry. Granular formulation may be spread on forage crops without harming pollinators.[4]

5. ENVIRONMENTAL PERSISTENCE

Relatively slow acting against houseflies, but with up to 8 weeks residual control.[3]

[i] SOIL — Low persistence in soil. Rapidly broken down by soil microorganisms and hydrolysis.[6] Half-life in aerobic soils ranges from 2 to 4 days[1], although half-lives of 4-16 days have been reported. Dimethoate adsorbs weakly to soil particles and may therefore leach.[6]

[ii] AQUATIC — Subject to hydrolysis (Half-life ~118 days at pH 7).[5] Not expected to bioaccumulate in aquatic organisms.[6]

[iii] ATMOSPHERIC — Degraded by reaction with hydroxyl radicals (estimated Half-life ~5 days).[5]

[iv] PHYTODEGRADATION — PEA POD SHELLS and PEA GRAINS: The half-life in shells and grains is 5.09 days and 1.63 days, respectively. Both shells and grains may be utilized without danger for canning, pickling, vegetables, etc. ten days after the last spraying.[9] PEACHES: Residue levels at 14 days from 3 x 40.0 g a.i./ha sprays were 1.0 μl/L.[7] APPLES: Residue levels at 14 days from 5 x 50.0 g a.i./ha were 0.86 μl/L, and from 7 x 50.0 g a.i./ha were 1.5 mg/kg.[7]

[v] OTHER — Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	180-330 mg/kg	Technical grade	6
Rat	NOEL 2y	1.0 mg/kg/diet		1
Rat	LD_{50} dermal	100-600 mg/kg		6
Mouse	LD_{50} oral	160 mg/kg		6
Guinea pig	LD_{50} dermal	>1000 mg/kg		2
Rabbit	LD_{50} oral	400-500 mg/kg		1
Human	ADI	0.01 mg/kg b.w.		1
Pheasant	LD_{50} oral	15.0 mg/kg	Male pheasants	1
Pheasant	LD_{50} oral	18.8 mg/kg	Significant ChE depression	8
Mallard	LD_{50} oral	41.7-63.5 mg/kg		6
Coturnix quail	LD_{50} oral	78.2-104.3 mg/kg	Significant ChE depression	8
Japanese quail	LC_{50} dietary 5d	341 ppm		6
Quail	LD_{50} oral	84.0 mg/kg		1
Hen	LD_{50} oral	25.0-50.0 mg/kg		5
Redwinged blackbird	LD_{50} oral	6.6-17.8 mg/kg		5
Rainbow trout	LC_{50} 24h	20.0 ppm		5
Rainbow trout	LC_{50} 48h	27.0 mg/L		5
Rainbow trout	LC_{50} 96h	6.2 mg/L	Static bioassay	5
Bluegill sunfish	LC_{50} 24h	28.0 ppm		5
Bluegill sunfish	LC_{50} 96h	6.0 mg/L		1
Mosquito fish	LC_{50} 96h	40.0-60.0 mg/L		1
Red crayfish	LC_{50} 48h	1.0 mg/L		5
Gammarus lacustris	*LC_{50} 96h*	*0.2 mg/L*	*Technical grade*	*5*
Stonefly	LC_{50} 48h	0.14 mg/L		5
Stonefly	LC_{50} 96h	0.043 mg/L	Technical grade	5
Channa punctatus	*LC_{50} 24h*	*68.0 mg/L*		*5*
Channa punctatus	*LC_{50} 48h*	*54.0 mg/L*		*5*
Channa punctatus	*LC_{50} 96h*	*47.0 mg/L*		*5*
Daphnia	*EC_{50} 24h*	*4.7 mg/L*		*1*
Daphnia	NOEC 24h	1.0 mg/L		1
Daphnia	*LC_{50} 48h*	*2.5 mg/L*		*5*

[i] TOXICITY (OTHER) — No irritation developed after application of 130 mg a.i. (as EC)/ 20 cm^2 skin in rabbits. Cholinesterase inhibitor. 32 p-labelled dimethoate absorbed rapidly from gut; radioactivity concentrated in liver, bile, kidneys, and urine. No accumulation in fat. Elimination rapid in humans and rats. Harmful or fatal if swallowed, inhaled, or absorbed through skin. Highly toxic to bees (LD50 oral 93-150 ng/bee).[5] Mammalian toxicity low enough for it to be considered for systemic control of cattle grubs.

[ii] PHYTOTOXICITY — Injury has been reported to American Elm, Norway Maple, Sunburst Locust, Mop-head Elm, Mock Orange, Morraine Locust and other ornamentals, as well as walnuts, peaches, hops, tomatoes, cotton and beans, Russeting appears on Red and Golden Delicious apples. Do not treat seedling citrus. Non-phytotoxic to common evergreen species at recommended rates.

7. METABOLISM

[i] ANIMAL - Rapidly metabolized in insects and mammals. Rats excreted about 50-60% of administered doses in urine, expired air, and faeces witin 24 hours.[6] Readily absorbed by gut. Four metabolites identified in rat have anti-ChE activity. Can inhibit non-specific esterases more strongly than AChE.

[i] PLANT – Not toxic to plants.[6]

8. ADDITIONAL INFORMATION

Effective against many insect larvae. Relatively slow acting against houseflies.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. PP
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Dimethomorph

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dimethomorph (BSI, draft E-ISO), dimethomorphe (draft F-ISO)[1]

[ii] TRADE NAME — Acrobat MZ, Forum (Cyanamid Crop Protection)

[iii] CHEMICAL NAME — (*E*,*Z*)-4-[3-(4-chlorophenyl)-3-(3,4-dimethoxyphenyl) acryloyl] morpholine

[iv] CAS # — 110488-70-5

[v] TYPE / MODE OF ACTION — Systemic fungicide with protective and curative action. Inhibits formation of cell walls in oomycetes.[1]

2. USE PATTERN

Effective against Peronosporaceae and *Phytophthora* spp. in vine crops, potatoes, and tomatoes.[1] Used in combination with contact fungicides including mancozeb and dithianon.

[i] APPLICATION — Apply to potatoes when disease threatens. Not registered for aerial application in the Atlantic provinces.[2]

[ii] RATES — 225 g a.i./ha. [2]

CARRIER: Water.

[iii] FORMULATIONS

1. WP is registered in Canada.
2. Other formulations include DC and WG.

[iv] SUGGESTED AQUATIC SETBACKS

1. Ground application: Calculated: 0 m, Label: 50 m adjacent to streams, ponds, rivers and lakes.
2. Air blast application: Not identified.
3. Aerial application: Label: 100 m of streams, ponds, rivers and lakes.
4. Forestry application: Not identified.

3. STORAGE

Store under cool, dry conditions in secure, well-ventilated buildings away from foodstuffs and animal feed and out of reach of children.[2]

4. HANDLING PRECAUTIONS

Use a maximum of three applications per season. Do not apply to terrain where there is potential for surface run-off to enter aquatic systems.[2] During all activities, worker must wear long pants, long-sleeved shirt and boots. During mixing, loading, clean-up and repair activities, workers must also wear chemical resistant gloves and safety goggles or a face shield. Do not re-enter treated areas for 48 hours following the application. For weeding and manual topping, do not re-enter treated area for 14 days.[2]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Moderately mobile. Aerobic soil metabolism DT_{50} 66-117 days; no degradates identified expcept for CO_2.[1]

[ii] AQUATIC – If released into water, dimethomorph is expected to adsorb to suspended solids and sediment in water based upon the estimated K_{oc}.[4]

[iii] ATMOSPHERIC – If released to air dimethomorph will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase dimethomorph will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals and ozone molecules; the half-lives for these reactions in air are estimated to be 4 and 1 hours, respectively. Particulate-phase dimethomorph will be removed from the atmosphere by wet and dry deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	3900 mg/kg		1
Rat	NOEL 90d	200 mg/kg diet		1
Mouse	LD_{50} oral	>5000 mg/kg	Male mice	1
Mouse	LD_{50} oral	3700 mg/kg	Female mice	1
Dog	NOEL 90d	450 mg/kg diet		1
Mallard	LD_{50} oral	>2000 mg/kg		1
Bluegill sunfish	LC_{50} 96h	>14.0 mg/L		1
Rainbow trout	LC_{50} 96h	6.2ppm		3
Carp	LC_{50} 96h	18.0 mg/L		1
Daphnia	*EC_{50} 48h*	*19.0-36.0 mg/L*		*1*

[i] TOXICITY — Not toxic to bees at 0.1 mg/bee.[1] Highly toxic to aquatic organisms.[2] Potential skin sensitizer.[2]

[ii] PHYTOTOXICITY - Non-phytotoxic. Metabolized only to a small degree in plants.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – The only significant component of the residue, when present, is the parent compound.[1]

8. ADDITIONAL INFORMATION

Not identified.

9. REFERENCES

1. PM
2. PMRA
3. ECOTOX
4. HSDB

Dinocap

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dinocap (BSI, E-ISO, F-ISO); DPC (JMAF); exception (Rep. of South Africa) for an isomeric reaction mixture.

[ii] TRADE NAME — Karathane (Dow AgroSciences); Dikar (Rohm and Haas Canada Inc.)

[iii] CHEMICAL NAME — Mixture of 2,4-dinitro-6-octylphenyl crotonate and 2,6-dinitro-4-octylphenyl crotonate

[iv] CAS # — 6119-92-2

[v] TYPE / MODE OF ACTION — Dinitro compound used as a contact fungicide and acaricide with protective and curative action.[1]

2. USE PATTERN

Non-systemic compound recommended for control of *Panonychus ulmi* on apples and powdery mildews on various fruits, grape vines, and ornamentals. Incompatible with oils and alkaline materials.[1]

[i] APPLICATION — Apply at 7-10 day intervals [4]; at no time should applications be more than 14 days apart. Usually 4-8 applications/season is adequate. Foliage should be thoroughly covered. Add a spreader-sticker to the spray solution. May be applied with ground boom, mist blower, airblast, or handhold sprayers.[7] May be used as a seed treatment. EC formulations are the most effective against mites.

[ii] RATES — Apple, pear, 139-228 g a.i./ 1000 L water. Cucumber (greenhouse), 68.0-114 g a.i./ 1000 L water. Ornamentals, 91.0-114 g a.i./ 1000 L water.[4]

CARRIER: Water.

[iii] FORMULATIONS

1. WP is registered in Canada.
2. Other formulations include EC, DP.

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 20 m
2.	Air blast application:	Calculated: 21(30) m
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Inflammable. All formulations must be packaged in water soluble bags.

4. HANDLING PRECAUTIONS

Do not use with oil/oil-based sprays or within 30 days of oil spray. Do not mix with parathion over the dosage of 62.4 g/500 L water. Do not apply in temperatures >32°C. Wash or wipe fruit or vegetables before using. Incompatible with lime sulphur. Do not graze treated areas. Use only dust or WP formulation on ornamentals. Compatible with other pesticides and most other fungicides and insecticides but do not use with oil-base sprays or with lime sulfur.[5]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Low persistence in soil. Half-life by microbial degradation is 4.5-6.1 days.[1] Highly photosensitive and readily broken down by sunlight; subject to microbial degradation.[6]

[ii] AQUATIC — Likely to sorb to suspended colloids, slightly soluble in water.[6] Estimated hydrolysis half-life in alkaline water is 129 days at pH 8.[5] Unlikely to contaminate groundwater.[6]

[iii] ATMOSPHERIC – If sprayed into the atmosphere, dinocap would exist primarily as an aerosol and be removed by gravitational settling. Vapor-phase dinocap reacts with photochemically- produced hydroxyl radicals and ozone in the atmosphere, with a resulting half-life of about a day.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	980 mg/kg	Technical grade	2
Rat	NOEL 2y	6.0-8.0 mg/kg/d	No carcinogenic effect	1
Rabbit	Oral gavage	3.0 mg/kg/d	Teratogenic effects	1
Rabbit	Dermal treatment	100 mg/kg/d	No teratogenic effects	1
Rabbit	LD_{50} dermal	>4700 mg/kg	Technical grade	1
Dog	LD_{50} oral	100 mg/kg		5
Dog	NOEL 2y	0.4 mg/kg/d	Cataracts produced	1
Japanese quail	LC_{50} oral	790 ppm	Commercial formulation	5
Rainbow trout	LC_{50} 96h	0.015 mg/L		6
Lake trout	LC_{50}	0.075 mg/L	Static bioassay	5
Bluegill sunfish	LC_{50} 96h	0.020 mg/L	Technical grade	5
Goldfish	LC_{50} 96h	0.033 mg/L		6

[i] TOXICITY (OTHER) — May cause skin irritation. Dinocap produces developmentally toxic effects in rabbits. For oral exposure, the NOEL for these effects is 0.5 mg/kg/day; for dermal exposure, the NOEL is 50.0 mg/kg/day.[7] It causes partial or complete otolith agenesis in the inner ear of the young house mouse (at 12.0 mg/kg/day dosed to pregnant female from day 7-16 of pregnancy) causing a loss of static equilibrium.[8] Highly toxic to fish. Not toxic to bees.[3] Moderately toxic to birds.[6] No reproductive effects noticed in animal studies; teratogenic potential; not carcinogenic.[6]

[ii] PHYTOTOXICITY — Considered non-phytotoxic. Greenhouse roses have been injured. The ester form is much less phytotoxic than the free-parent phenol.[3]

7. METABOLISM

[i] ANIMAL - In rats, following oral administration, dinocap is almost entirely excreted rapidly in the faeces, with a small amount in the urine.[1] Nitro groups are reduced to amino groups and ester hydrolysis also takes place.[1] Readily eliminated through urine and faeces in mammalian systems; biological accumulation unlikely.[6]

[ii] PLANT – Metabolism follows the same course as animals.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. PP
7. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
8. Earl Gray, Jr, L., J.M. Rogers, J.S. Ostby, R.J. Kavlock and J.M. Ferrell (1988) Prenatal dinocap exposure alters swimming behaviour in mice due to complete otolith agenesis in the inner ear. *Toxicology and Appl. Pharmacology*. Vol 92: 266-273.

Diphacinone

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — diphacinone (BSI, E-ISO, F-ISO, ANSI); diphacins (JMAF); diphenadione (BAN); diphacin (Former exception, Turkey); exception (Italy)

[ii] TRADE NAME — Diphacin (Hopkins Agricultural Chemical Co.), White Lightening, *Nox All Moucide Meal* (Nox-All Products Ltd.)

[iii] CHEMICAL NAME — 2-(diphenylacetyl)indan-1,3-dione

[iv] CAS # — 82-66-6

[v] TYPE / MODE OF ACTION— Organic compound used as an anti-coagulant rodenticide.

2. USE PATTERN

Control rats, mice, squirrels, and other rodents.

[i] APPLICATION — Place poisoned bait in locations readily accessible by rodents. Continuous feeding necessary for complete kill. Control requires approximately 2 weeks.[3]

[ii] RATES — Use at a 0.005% concentration in cereal, apple, meat, and fish baits.

CARRIER: Food for bait.

[iii] FORMULATIONS

1. SO
2. DU
3. PE
4. PT
5. The sodium salt is also available to be mixed with water.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Not identified.
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application	Not identified.

3. STORAGE

Keeps for long period of time. Stable to hydrolysis and mild oxidizing agents. Rapidly decomposed in water by sunlight. Decomposes at 338°C.[1]

4. HANDLING PRECAUTIONS

Never let bait run out as continuous feeding is necessary. Pick up and dispose baits on completion of control program.

5. ENVIRONMENTAL PERSISTENCE

Long persistence; does not lose effectiveness.

[i] SOIL – Low potential to leach in soil.[1] Moderately persistent to persistent to aerobic soil degradation (Half-lives ~26 to 178 days).[4]

[ii] AQUATIC – Rapidly decomposed in water by sunlight.[1] Little if any contamination of ground and surface waters expected.[4]

[iii] ATMOSPHERIC – If released to air will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase dipacinone will be removed from the atmosphere by wet and dry deposition.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1.86-2.88 mg/kg		2
Rat	LC_{50} inhalation 4h	<2.0 mg/L air		1
Rat	LD_{50} dermal	<200 mg/kg		1
Mouse	LD_{50} oral	340 mg/kg		1
Cat	LD_{50} oral	14.7 mg/kg		1
Dog	LD_{50} oral	3.0-7.5 mg/kg		1
Mallard	LD_{50} oral	3158 mg/kg		1
Rainbow trout	LC_{50} 96h	2.8 mg/L		1
Bluegill sunfish	LC_{50} 96h	7.6 mg/L		1

[i] TOXICITY (OTHER) — Continued LD_{50} is 0.2 mg/kg/day. LD_{50} chronic for albino rat 0.1 mg/kg/day.[1] Slightly toxic to birds, moderately toxic to fish species.[1] Non-irritating to skin and eyes.[5] Non-mutagenic.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i]ANIMAL – Any metabolism mainly involves hydroxylation and conjugation.[1] Animal studies indicate that little metabolism takes place, and that diphacinone that is not eliminated may concentrate to varying degrees in the liver, kidneys, and lungs.[1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Only a slight danger of secondary poisoning to a domestic animal.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PP
5. HSDB

Diquat dibromide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — diquat, dibromide (BSI, E-ISO, F-ISO, ANSI, WSSA, JMAF); deiquat (FRG); reglon (former exception, USSR)

[ii] TRADE NAME — Reglone, Gramoxone (Zeneca Agro); Weedrite (Wilson Laboratories Inc., Interprovincial Co-op Ltd.), Desiquat (Barclay); Reglex (Caffaro).

[iii] CHEMICAL NAME — 9,10-dihydro-8a,10a-diazoniaphenanthrene

[iv] CAS # 2764-72-9

[v] TYPE / MODE OF ACTION — A pyridine compound (used as diquat dibromide). Non-selective contact herbicide, desiccant, and algicide. Absorbed by foliage, causes the generation of superoxides during photosynthesis. These superoxides damage cell membranes and cytoplasm.[1]

2. USE PATTERN

Diquat dibromide is registered as a non-crop weed killer, a general aquatic herbicide, and as a pre-harvest top killer or desiccant of seed crops. It is useful around woody ornamentals. It controls practically all annual plants contacted, as well as aquatic weeds. Annual grasses are less susceptible than broadleaf plants.[3]

[i] APPLICATION — DESICCATION: Apply from ground or air for complete coverage of above ground portions of plant. AQUATIC WEED CONTROL: Submerged weeds: Water treatments may be applied by injecting below the water surface, or by pouring diluted solution (1:4 with water) into the water body from a slow moving boat. Distribute evenly over infested areas. Floating weeds: apply by thoroughly wetting foliage. NON-CROP WEED CONTROL: Cover fully to point of run-off. Better control will be obtained by applying as early as possible in weed development. This product may be applied with different soil sterilants to give 'rapid knockdown' effects.[3]

[ii] RATES — Effective at very low dosages.[3] Vegetables/Field Crops/Non-cropland, 550-1100 g a.i./ha. Potato, 300-850 g a.i./ha. Aquatic weeds, 2.2-4.4 kg a.i./ha.[5]

CARRIER: Water 168-1100 L/ha for ground spraying. 47-94 L/ha for aerial spraying with the addition of x-77 or other nonionic or cationic.[4] SURFACTANT: dilute spray - 25.0 mL/100 L. Concentrate spray - 12.5 mL/10 L.

[iii] FORMULATIONS

1. SL
2. Gel

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Label: 15 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Under normal storage conditions, in original containers, shelf life is indefinitely long. The dry chemical is somewhat sensitive to UV light. The product is stable to heat beyond the range of ordinary ambient temperatures. The solution does not crystallize at 0°C. Stable in acid and neutral solutions and unstable under alkaline conditions. May be inactivated by invert clay and by anionic surfactants. Unformulated compound is corrosive to most common metals[2], especially aluminum and zinc, but formulated product contains corrosive inhibitors enabling aqueous solutions to be applied by spray machinery. To be stored away from direct sunlight and above 0°C.

4. HANDLING PRECAUTIONS

Not identified.

5. ENVIRONMENTAL PERSISTENCE

Very long persistence. Diquat dibromide is photodegradable.[9]

[i] SOIL — Highly persistent. Preferential adsorption by organic material and clay minerals significantly reduces microbial and photochemical degradation in soils and water.[6] Rapidly and completely inactivated on contact with soil.[1] Binds tightly to the upper soil layers.

[ii] AQUATIC — Diquat dibromide disappears from treated water quite rapidly due to absorption and concentration by aquatic plants and sediment (half-life 2-4 weeks).[6]

[iii] ATMOSPHERIC - If released to air diquat dibromide will exist in the particulate phase in the ambient atmosphere. Particulate-phase diquat dibromide will be removed from the atmosphere by wet and dry deposition. Diquat has an absorption maximum at 310 nm and is therefore susceptible to UV decomposition. However, when adsorbed on particulate matter, no photodegradation occurs.[6]

[iv] PHYTODEGRADATION — Metabolic breakdown does not occur. Photochemical decomposition occurs on plant surfaces.[1]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	120 mg/kg		7
Rat	NOEL 2y	0.25 mg/kg b.w./d		1
Mouse	LD_{50} oral	233 mg/kg		7
Rabbit	LD_{50} oral	187 mg/kg		1
Rabbit	LD_{50} dermal	400-500 mg/kg		7
Dog	LD_{50} oral	100-200 mg/kg		1
Dog	NOEL 4y	50.0 mg/kg diet		1
Cow	LD_{50} oral	30.0-56.0 mg/kg		7
Mallard	LD_{50} oral	564 mg/kg		7
Partridge	LD_{50} oral	295 mg/kg		1
Hen	LD_{50} oral	200-400 mg/kg		7
Bobwhite quail	LC_{50} oral	2932 ppm		6
Pheasant	LC_{50} oral	3742 ppm		6
Japanese quail	LC_{50} dietary 5d	1300 ppm		7
Rainbow trout	LC_{50} 48h	11.2 mg/L		6
Rainbow trout	LC_{50} 96h	21.0 mg/L		1
Brown trout	LC_{50} 96h	300 mg/L		6
Bluegill	LC_{50} 96h	245 mg/L		7
Chinook salmon	LC_{50} 48h	28.5 mg/L		6
Largemouth bass	LC_{50} 96h	7800 mg/L		6
Northern pike	LC_{50} 48h	16000 mg/L		6
Mirror carp	LC_{50} 96h	67.0 mg/L		1
Yellow perch	LC_{50} 96h	60.0 mg/L		7
Guppy	LC_{50} 96h	50.2 mg/L		6
Fathead minnow	LC_{50} 96h	14000 mg/L		6
Gammarus fasciatus	*LC_{50} 96h*	*100 mg/L*		*6*
Hyalella azteca	*LC_{50} 96h*	*48.0 mg/L*		*6*

[i] TOXICITY (OTHER) — Generally safe to wildlife and fish at recommended rates.[10] Tolerance of 0.05 mg/kg established on sugarcane. Absorption through intact skin is minimal except on prolonged exposure. Diquat dibromide is a severe skin and eye irritant. Can cause temporary damage to nails and nose bleeding if inhaled. Only pathological symptom in long-term feeding trials is an occurrence of bilateral cataracts. A 10.0 mg/L treatment to *Rana pipiens* at the early gastrula stage resulted in the loss of 65.9% by day 16.[8]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL - Readily excreted, largely as metabolites. Following oral administration in rats, 77% of the dose appeared in faeces as diquat dibromide, and 12% as metabolic products. Diquat monopyridone made up roughly half of these metabolic products.[6]

[ii] PLANT – Metabolic breakdown of diquat dibromide does not occur in plants. On plant surfaces, photochemical degradation occurs.[1]

8. ADDITIONAL INFORMATION

Not advisable to store undiluted diquat dibromide with metals (corrosive). The undiluted material is best kept in the original containers. Do not spray crops wet from rain or spray around desirable crops. Application should not be carried out during windy periods or times of thermal inversions. Rapidly absorbed by aerial parts of plants.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. PMRA
6. HSDB
7. PP
8. Dial, N.A. and C.A. Bauer Dial (1987) Lethal effects of diquat and paragnot on developing frog embryos and 15-day-old tadpoles (Rana pipiens). Cull. *Environ. Contam. Toxicol.* 38: 1006-1011.
9. Reinert, K.H. and J.H. Rodgers (1987) Fate of aquatic herbicides. Reviews of Environmental Contamination and Toxicology 98: 61-98.
10. Simsiman, G.V., T.C. Danial and G. Chesters (1976) Diquat and endothall: their fates in the environment. Residue Reviews 62: 131-174.

Disulfoton

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — disulfoton (BSI, E-ISO, F-ISO, ESA); ethylthiodemeton (JMAF); *M-74* (former exception, USSR)

[ii] TRADE NAME — Di-Syston (Bayer Inc.)

[iii] CHEMICAL NAME — *0,0*-diethyl *S*-2 ethylthioethyl phosphorodithioate

[iv] CAS # — 298-04-4

[v] TYPE / MODE OF ACTION — Organophosphorus insecticide and acaricide (phosphorodithioate group) with systemic activity. Structurally similar to demeton and related compounds. Cholinesterase inhibitor.

[vi] NOTICE — **Disulfoton is being phased out and discontinued in Canada with registration and sales ending July 1, 2005**. The U.S. EPA also plans to phase-out usage of disulfoton products on several crops by June 2005. This U.S. phase-out follows requests from three registrants who proposed to cancel and/or delete certain crop uses from disulfoton product labels.

2. USE PATTERN

For the control of aphids, leafhoppers, thrips, beet flies, coffee leaf miners, and mites. Used on a great variety of crops, including vegetables, potatoes, sugarbeets, cotton, and cereals. Chiefly applied at sowing or as a seed dressing. A seed treatment is particularly effective against sucking insects. Also prevents cucumber mosaic and potato leaf roll viruses by controlling vectors.[1]

[i] APPLICATION — Drilling, side dressing, or broadcasting. Broadcast treatment may be applied by air or by ground equipment. Can be applied pre-plant, pre-emergence, or post-emergence. On fruit trees, spread from trunk to drop line beneath tree. Work into soil and water thoroughly. Also applied as a seed coating and as a mixture with dry or liquid fertilizer. Used on some crops as a foliar insecticide.

[ii] RATES — Field crops, 1.13 kg a.i./ha. Vegetables, 5.55-30.0 g a.i./100 m of row. Non-bearing fruit trees, 10.5-101.25 g a.i./tree. Ornamentals, 48.75-101.25 g a.i./100 m of row.[2]

CARRIER: Other pesticides and water.

[iii] FORMULATIONS

1. GR and EC are registered in Canada.
2. DS

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 26-33 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Relatively stable to hydrolysis below pH 8.0. Compatible with most pesticides.

4. HANDLING PRECAUTIONS

Keep all unprotected persons out of the area until residues have dissipated. Do not use in greenhouses.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Rapid breakdown by biodegradation and hydrolysis. Half-life 1-4 days.[3] Medium to low mobility in soil. Mobility increases with soil organic matter.[4]

[ii] AQUATIC — Half-life is 5-12 hours depending on the season.[3] Degradation in water is dependent on temperature and pH.

[iii] ATMOSPHERIC - If released to air disulfoton will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase disulfoton will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 3 hrs. Particulate-phase disulfoton will be removed from the atmosphere by wet and dry deposition. Disulfoton does not directly photolyze due to the lack of absorption in the environmental UV spectrum.[3]

[iv] PHYTODEGRADATION — Rapidly metabolized. Control may persist for 6-8 weeks.[4]

[v] OTHER — Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	6.2-12.5 mg/kg	Males	4
Rat	LD_{50} oral	1.9-2.5 mg/kg	Females	4
Rat	LD_{50} dermal	15.9 mg/kg	Males	1
Rat	LD_{50} dermal	3.6 mg/kg	Females	1
Rat	NOEL 2y	1.0 mg/kg diet		1
Dog	NOEL 2y	1.0 mg/kg diet		1
Goat	LD_{50} oral	<15.0 mg/kg		3
Human	ADI	0.0003 mg/kg b.w.		1
Mallard	LD_{50} oral	6.54 mg/kg		3
Mallard	LC_{50} dietary 5d	692 ppm		4
Bobwhite quail	LD_{50} oral	39.0 mg/kg		1
Japanese quail	LC_{50} dietary 5d	333 ppm		3
Pheasant	LC_{50} dietary 5d	634 ppm		3
Rainbow trout	LC_{50} 24h	4.32 mg/L		5
Rainbow trout	LC_{50} 96h	3.0 mg/L		1
Bluegill	LC_{50} 24h	0.09 mg/L		5
Bluegill	LC_{50} 96h	0.3 mg/L		3
Channel catfish	LC_{50} 96h	4.7 mg/L		3
Largemouth bass	LC_{50} 96h	0.06 mg/L		3
Goldfish	LC_{50} 96h	7.2 mg/L		5
Fathead minnow	LC_{50} 24h	4.41 mg/L		5
Fathead minnow	LC_{50} 96h	4.0 mg/L		5
Stonefly	EC_{50} 24h	0.04 mg/L		5
Stonefly	EC_{50} 96h	0.005 mg/L		5
Gammarus lacustris	*EC_{50} 24h*	*0.11 mg/L*		*5*
Gammarus lacustris	*EC_{50} 96h*	*0.052 mg/L*		*5*
Gammarus fasciatus	*LC_{50} 24h*	*0.11 mg/L*		*5*
Gammarus fasciatus	*LC_{50} 96h*	*0.027 mg/L*		*5*
Daphnia	*EC_{50} 48h*	*0.013-0.064 mg/L*		*1*

[i] TOXICITY (OTHER) — Cholinesterase inhibitor. No effect on reproduction; test for teratogenicity and carcinogenicity negative. Toxic to fish. Toxic to bees depending on the mode of application. Absorbed through skin. Mutagenic in bacteria, no evidence that disulfoton is carcinogenic.[4]

[ii] PHYTOTOXICITY — High dosages may injure seeds. Do not apply within direct contact of the seed. On cotton, sugar beets, tomatoes, beans, or lettuce maximum dose may cause some delay of emergence and stunting in cool, wet weather. Injury may be more pronounced on light sandy soil. Injury may be enhanced when used with certain pre-emergence herbicides. Absorbed through roots. Non-phytotoxic when used as directed.[1]

7. METABOLISM

[i] ANIMAL - Metabolized by thionate oxidation, thioether oxidation, and hydrolysis or oxidative cleavage. Thionate oxidation would result in demeton, which is further degraded. In rats, disulfoton is rapidly absorbed by the gastrointestinal tract, metabolized, and excreted via urine.[4]

[ii] PLANT - Plant and soil metabolism studies indicate formation of sulphoxides and sulphones of disulfoton and the oxygen analogue (demeton-S). Ratios of these metabolites can vary and depend on plant variety, soil type, and climatic conditions.

8. ADDITIONAL INFORMATION

Impurities of technical product have been identified and quantified. Residues appear stable under deep-freeze conditions; losses of residues occur during heating, cooking or peeling in the case of potatoes.

9. REFERENCES

1. PM
2. PMRA
3. HSDB
4. PP
5. CESARS

Diuron

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — diuron (BSI, E-ISO, F-ISO, ANSI, WSSA); DCMU (JMAF); dichlorfenidim (former exception, USSR)

[ii] TRADE NAME — Mag-x-cide, Krozine (Chempara Corp. Ltd.); Krovar I (DuPont Canada Inc.); Tofa-col (Chipman Inc.); Triox (Chevron Chemical)

[iii] CHEMICAL NAME — 3-(3,4,-dichlorophenyl)-1,1-dimethylurea

[iv] CAS # — 330-54-1

[v] TYPE / MODE OF ACTION — Diuron is a substituted urea compound used as a pre- and post- emergence herbicide

2. USE PATTERN

Low rates selectively control germinating broadleaf and grass weeds in crops such as cotton, sugarcane, pineapple, grapes, apples, pears, and alfalfa. At higher rates it is a general weed killer. Recommended for control of seedling weeds in asparagus and grapes. Used for weed control on non-cropland, drainage ditches, and contained water bodies for control of pond weed.

[i] APPLICATION — For selective weed control, it is sprayed on soil as a pre-emergence and/or as a directed post-emergence treatment. Weeds up to 5 cm high controlled when a suitable surfactant is added to spray suspension. For a general weed control, spray or spread granules when ground is frozen and just before weed growth begins. Dense growth should be removed before application. On cropland, work the soil into a desired seedbed before applying. Do not disturb soil after treatment. Diuron may be applied to certain crops by air. The use of a surfactant greatly increases its knockdown effects and contact activity.[3] Keep agitated during application.

[ii] RATES — Non-crop weed control, 11.2-53.6 kg/ha; 5.0-20.0 kg/ha-metre(aquatic) Crops, 0.88-5.4 kg/ha in 250-400 L water.

CARRIER: Water in sufficient volume to cover area. Oil suspensions can also be used.

[iii] FORMULATIONS

1. IF
2. EC
3. GR
4. SU
5. WP
6. SG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 11-14 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Liquid suspensions should not be subjected to freezing temperatures. Non-flammable, non-volatile, and non-corrosive. Stable to oxidation and moisture. Rate of hydrolysis is negligible under normal conditions but increased under acidic/alkaline conditions or at higher temperatures.

4. HANDLING PRECAUTIONS

Do not use on light, sandy soils in crop areas or on cloddy soil. Do not plant a susceptible crop within 12 months of treatment. Do not use on lawns or dwarf fruit trees. Do not use where it is likely to leach or wash into contact with roots of desirable trees or shrubs.[6] Avoid contact with skin, eyes, clothing and avoid inhaling dust or spray mist.

5. ENVIRONMENTAL PERSISTENCE

At low rates, it should persist for only one season. At higher rates, diuron may persist more than one season. Losses by photodecomposition or volatilization probably insignificant unless diuron is exposed for several days or weeks under hot, dry conditions.[4]

[i] SOIL — 1.1-3.4 kg/ha applied to moist, loam soil persisted 3-6 months. 2.2 kg/ha applied in soil persisted >15 months. Degraded in soil by methylation.[7] Phytotoxic residues in soil disappear within 1 season at 0.6-4.8 kg/ha.[7] Adsorption increases as clay content and/or organic matter increases; adsorbed at a greater rate than monuron. Leaching is not believed to be important in loss from most soils.[4] Microbial action is the main factor in disappearance from soil.[4] Does not leach over 2.5 cm when applied at proper rates.[3]

[ii] AQUATIC – Diuron is relatively stable in neutral water; microbes are the primary agents in the degradation of diuron in aquatic environments.[8]

[iii] ATMOSPHERIC - If released to air diuron will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase diuron will be removed from the atmosphere by wet and dry deposition. Diuron absorbs light in the environmental UV spectrum and may degrade by direct photolysis.[9]

[iv] PHYTODEGRADATION — 95 days after treatment 0.5-3.0 µl/L was found in vegetation in ponds.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	3400 mg/kg		2
Rat	NOEL 2y	250 mg/kg diet		1
Dog	NOEL 2y	125 mg/kg diet		1
Human	ADI	0.002 mg/kg		1
Bobwhite quail	LC_{50} dietary 8d	1730 mg/kg		1
Japanese quail	LC_{50} dietary 8d	>5000 mg/kg		1
Mallard	LC_{50} dietary 8d	>5000 mg/kg	Ducklings	1
Pheasant	LC_{50} dietary 8d	>5000 mg/kg	Chicks	1
Largemouth bass	LC_{50} 48h	42.0 mg/L		
Coho salmon	LC_{50} 48h	16.0 mg/L		
Rainbow trout	LC_{50} 48h	5.6 mg/L		1
White crappies	LC_{50}	60.0 mg/L		
Bluegill	LC_{50} 24h	27.0 mg/L	12.7°C	
Bluegill sunfish	LC_{50} 96h	5.9 mg/L		1
Bluegill	LC_{50} 24h	9.7 mg/L	23.8°C	
Striped bass	LC_{50} 96h	3.1 mg/L		
Guppy	LC_{50} 96h	25.0 mg/L		1
Stonefly	LC_{50} 24h	3.6 mg/L		
Stonefly	LC_{50} 48h	2.8 mg/L		
Gammarus lacustris	*LC_{50} 24h*	*0.7 mg/L*		
Gammarus lacustris	*LC_{50} 48h*	*0.380 mg/L*		
Daphnia	*EC_{50} 48h*	*12.0 mg/L*		*1*
Daphnia pulex	*LC_{50} 48h*	*1.4 mg/L*		
Daphnia magna	*EC_{50} 48h*	*47.0 mg/L*	*Immobilization at 15.5°C*	
Daphnia pulex	*EC_{50} 48h*	*1.4 mg/L*	*Immobilization at 15.5°C*	
Simocephalus serrulatus	*EC_{50} 48h*	*2.0 mg/L*	*Immobilization at 15.5°C*	

[i] TOXICITY (OTHER) — Low toxicity to man and livestock.[6] May irritate eyes, nose, throat, and skin. Not toxic to bees[1] Slightly toxic to birds.[8] Diuron is teratogenic at high does; does not appear to be mutagenic.[8]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In dairy cows, 50% of diuron is recovered in urine, 10% in faeces, and 5% in blood. No diuron was recovered in milk.[5] In mammals, metabolism is principally by hydroxylation and dealkylation.[1]

[ii] PLANT – In plants, diuron undergoes demethylation of the nitrogen atom and hydroxylation at position 2 of the benzene ring.[1]

8. ADDITIONAL INFORMATION

Diuron and certain ester formulations of hormone weed killers may create a physical problem in the spray tank. It may not be suitable on hard-to-kill or deep-rooted perennial weeds.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. Kalra, S.K. and K.S. Chahal (1979) Degradation of diuron (3(3,4-dichlorophenyl)-1,1-dimethylurea) in cows. *Ecotoxicol. Environ. Safety* 3: 362-268.
6. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control*. 101 pp.
7. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
8. PP
9. HSDB

Dodine

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — dodine (BSI, E-ISO, F-ISO, ANSI); doguadine (France); tsitrex (former exception, USSR)

[ii] TRADE NAME — Cyprex (Cyanamid Canada Inc.); Equal (Norac Concepts Inc.)

[iii] CHEMICAL NAME — 1-dodecylguanidinium acetate

[iv] CAS # — 2439-10-3

[v] TYPE / MODE OF ACTION— Organic compound used as a slimicide and an eradicant and preventative foliar fungicide.

2. USE PATTERN

Controls apple scab, fruit rot, cherry leaf spot, brown rot, leaf curl, leaf scorch, and other fungal diseases. Some control of powdery mildew.

[i] APPLICATION — Apply before symptoms appear and repeat at specified intervals, usually 5-10 days. With apple scab, apply within 36 hours of wet periods which caused infection. Keep agitated during mixing and spraying.

[ii] RATES — 1.14-2.11 kg a.i./ha in 1750-4500 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. SN
2. WP
3. DU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: 0 m
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Stable under moderately acidic or alkaline conditions. Biological activity remains practically unvaried for 3 years under environmental conditions. Store away from food and feed under proper storage conditions.[2]

4. HANDLING PRECAUTIONS

Keep container closed when not in use. Transfer or mix under conditions of adequate ventilation. Do not get in eyes or on skin. Wear goggles or face shield when handling. Wear rubber gloves. Do not breathe dust. Wash thoroughly after use. Do not graze cover crops in treated orchards or feed crop residue to livestock. Incompatible with chlorobenzilate, lime, oils, and oil emulsions. Compatible with anionic surfactants and hard water.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Dodine is of low persistence in soil (Half-life ~20 days).[5]

ii] AQUATIC – It is soluble in water but binds strongly to soil and is therefoe unlikely to contaminate groundwater.[5]

[iii] ATMOSPHERIC – Dodine will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase dodine will be removed from the atmosphere by wet and dry deposition.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	c.1000 mg/kg	Males	1
Rat	LD$_{50}$ oral	1460 mg/kg		3
Rat	NOEL 2y F.T.	800 mg/kg diet	Slight growth retardation, no effect on reproduction	1
Rabbit	LD$_{50}$ dermal	>1500 mg/kg		1
Human	Skin sensitization 21d		No sensitization	3
Human	ADI	0.01 mg/kg		1
Human	ADI	0.0013 mg/kg	Provisional	3
Mallard	LD$_{50}$ oral	1142 mg/kg		1
Japanese quail	LD$_{50}$ oral	788 mg/kg		1
Rainbow trout	LC$_{50}$ 96h	570 ppm		4
Harlequin fish	LC$_{50}$ 48h	0.53 mg/L		1
Harlequin fish	LC$_{50}$ 96h	0.6 mg/L		1

[i] TOXICITY (OTHER) — Non-toxic to honey bees at normal rates of usage (LD$_{50}$ topical >0.011 mg/bee).[1] Irritating to the skin. Slightly toxic to birds, highly toxic to freshwater fish.[3] Does not appear to be mutagenic.[5]

[ii] PHYTOTOXICITY — Peaches and plums injured in Eastern U.S. Russeting has occured on Golden Delicious, Grimes, and R.I. Greening apples. Raspberries may be injured.[1]

7. METABOLISM

[i] ANIMAL – In rats, 95% of the applied dose is eliminated in urine and faeces within 8 days; approximately 74% of excreted material is unchanged dodine; metabolites include creatine and guanidine derivatives.[1]

[ii] PLANT – In plants, dodine is converted to creatine by the action of a methyltransferase and simultaneous oxidative cleavage of the dodecyl moiety.[1]

8. ADDITIONAL INFORMATION

Displays eradicant as well as protective properties. Local systemic activity.

9. REFERENCES

1. PM
2. FCH
3. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
4. ECOTOX
5. PP
6. HSDB

Endosulfan

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — endosulfan (BSI, E-ISO, F-ISO, ANSI, ESA); thiodan (Iran, USSR); benzoepin (JMAF); exception (Italy)

[ii] TRADE NAME — Thiodan (Agr Evo Canada Inc.); Clean Crop Endosulfan (United Agri Products); Thionex (Makhteshim Agan). Other names include Endosulfan 400 and Wilson's Endosulfan.

[iii] CHEMICAL NAME — (1,4,5,6,7,7-hexachloro-8,9,10-trinorborn-5-en-2,3-ylenebismethylene) sulphite. Endosulfan consists of a mixture of two stereoisomers: alpha (a)-endosulfan and beta (b)-endosulfan.

[iv] CAS # — 115-29-7

[v] TYPE / MODE OF ACTION — Non-systemic organochlorine insecticide and acaricide with stomach and contact action.[1]

[vi] NOTICE — Endosulfan products are **currently under re-evaluation** in Canada. Canadian manufacturers of the technical product have indicated that after consultation with stakeholders, risk-management plans and cancellation of certain uses may be implemented. In 2002, the U.S. EPA announced a risk-management plan for endosulfan including the cancellation of certain uses. Risk-management for remaining endosulfan uses involves measures to decrease worker and environmental risks, including reducing application rates and establishing set backs and buffers to protect water.

2. USE PATTERN

Broad spectrum insecticide used to control aphids, thrips, beetles, foliar feeding larvae, mites, borers, cutworms, bollworms, bugs, whiteflies, leafhoppers, and slugs. Used on citrus and small fruits, vegetables, potatoes, forage, oil and fibre crops, grains, tobacco, coffee, tea, forests, and ornamentals. Controls termites and tsetse fly. Compatible with most pesticides.

[i] APPLICATION — Uniform coverage with common application equipment. Apply when insects first appear; repeat as necessary.

[ii] RATES — Vegetables, 0.6-1.1 kg a.i./ha. Corn (sweet and field), 1.1-1.7 kg a.i./ha. Fruit crops, 0.7 kg a.i./1000 L water. Ornamentals, 0.5-0.7 kg a.i./1000 L water.[1] Oil soluble.

CARRIER: Water, oil.

[iii] FORMULATIONS

1. WP
2. EC
3. DU are registered in Canada.
4. Other formulations include GR, SC, DP.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 46-58 m
2. Air blast application:	Calculated: 53(63)-66(77) m
3. Aerial application:	Calculated: >1000 m
4. Forestry application:	Not identified.

3. STORAGE

Stable to sunlight. Subject to slow hydrolysis to the diol and SO_2.[1] Non-flammable; corrosive to iron. Do not store under 20°F.[4]

4. HANDLING PRECAUTIONS

Do not feed treated crop residues to livestock. Wear protective clothing when entering field up to 24 hours after application. Do not breathe dust or spray mist. Do not get in eyes, on skin, or on clothing. Wash hands immediately after handling. Do not apply to crops to be followed by a root crop other than carrots, potatoes, sweet potatoes, or sugar beets. Incompatible with calcium arsenate, lime, and zinc sulphate.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — a-endosulfan disappears rapidly while b-endosulfan is very persistent (75% remains in soil for 2 yrs).[7] Persistence has led to accumulation in body fat.[8] Principal degradation product (endosulfan sulphate) also highly persistent.[7] Moderate capacity to adsorb to soil particles. Volatilization and leaching are not expected to be significant.[4]

[ii] AQUATIC — Peak residues in surface runoff dissipate quite quickly, usually below detection by 2 weeks. Isomers are expected to hydrolyze slowly under neutral conditions (half-life 35.4-37.5 days at pH 7). [4] Appreciable leaching only at high application rates.[7] Endosulfan and the sulphate may persist in sediments. Aquatic organisms (except sediment dwellers) exposed to short-term peak concentrations rather than to chronic exposure.[7] Can be degraded by aquatic micro-organisms in well oxygenated water; at 20°C under these conditions the half-life was one week in the presence of *Pseudomonas* spp.[7]

[iii] ATMOSPHERIC - If released to air endosulfan will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase endosulfan will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 2 days. Particulate-phase endosulfan will be removed from the atmosphere by wet and dry deposition. Endosulfan may undergo direct photolysis, but the kinetics of this reaction are unknown.[4]

[iv] PHYTODEGRADATION — For most fruits and vegetables, 50% of residue is lost in 3-7 days.[1] Rapidly broken down to the corresponding sulphate.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	76.0 mg/kg	Alpha-isomer	1
Rat	LD_{50} oral	240 g/kg	Beta-isomer	1
Rat	LD_{50} dermal	>4000 mg/kg	Males	1
Rat	LD_{50} dermal	500 mg/kg	Females	1
Rat	NOEL 2y F.T.	30.0 mg/kg diet	No ill-effect	1
Rabbit	LD_{50} dermal	359 mg/kg		2
Dog	NOEL 1y	3.0 mg/kg diet		1
Human	ADI	0.006 mg/kg b.w.		1
Mallard	LD_{50} oral	31.0-243 mg/kg		6
Pheasant	LD_{50} oral	80.0-320 mg/kg		6
Japanese quail	LC_{50} dietary 5d	2906 ppm		6
Bobwhite quail	LC_{50} oral	805 ppm		4
Rainbow trout	LC_{50} 96h	0.0014 mg/L		4
Bluegill sunfish	LC_{50} 96h	0.0012 mg/L		4
Channel catfish	LC_{50} 96h	0.0015 mg/L		4
Carp	LC_{50} 48h	0.01 mg/L		4
Rohu	LC_{50} 96h	0.0071 mg/L		5
Goldfish	LC_{50} 24h	0.008 mg/L		4
Stickleback	LC_{50} 24h	<0.004-<0.011 mg/L	pH 7.2-9.0, various temp. and DO	11
Fathead minnow	LC_{50} 96h	0.0014 mg/L		6
Stonefly	LC_{50} 96h	0.0023 mg/L		4
Caddis fly larvae	LC_{50} 24h	0.072-0.174 mg/L	pH 7.2-9.0, various temp. and DO	11
Bivalve mollusc	LC_{50} 24h	>0.607 mg/L	pH 7.5-9.0, various temp. and DO	11
Bloodworms	LC_{50} 24h	>0.607 mg/L	pH 7.5-9.0, various temp. and DO	11
C.septemspinosa	*LC_{50} 96h*	*0.2 µg/L*	*In seawater. 10-80 times less toxic in sandy sediment*	*9*
Gammarus lacustris	*LC_{50} 96h*	*0.0058 mg/L*		*4*
Sigara alternata	*EC_{50} 24h*	*0.013-0.269 mg/L*	*pH 7.9-9.0, various temp. and DO*	*11*
Daphnia	*EC_{50} 48h*	*0.075-0.75 mg/L*		*1*
Daphnia	*EC_{50} 24h*	*>0.607 mg/L*	*pH 7.8-9.1, various temp. and DO*	*11*

[i] TOXICITY (OTHER) — High mammalian toxicity.[8] Central nervous system stimulant. Toxic to fish and birds, moderately toxic to bees. Relatively non-toxic to beneficial insects.[6] Practical use should be harmless to wildlife.[1] Indiscriminate activity against beneficial insects.[8] Readily absorbed through skin.[8] Systemic absorption may occur. Potentially teratogenic and mutagenic.[6]

[ii] PHYTOTOXICITY – Glasshouse geraniums and chrysanthemums, alfalfa, and lima beans may be injured.[1]

7. METABOLISM

[i] ANIMAL – Metabolized to corresponding sulphate which is toxicologically similar to endosulfan. Excreted as conjugates of the diol and other highly polar metabolites depending on the species. In rats, mice, dogs, sheep, cows, and pigs, endosulfan sulphate is found in body fat and milk while hydrolysis products (*e.g.*, diol) are excreted.[7] Residues tend to accumulate in the kidney rather than fat but are rapidly eliminated.[1] Does not accumulate in the body.[10] Spray residues protected from reaction by low solubility; when they enter living tissue they are rapidly broken down.[8]

[ii] PLANT – Rapidly broken down to the corresponding sulfate. On most fruits and vegetables, 50% of the parent residue is lost within 3 to 7 days.[6]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. PMRA
4. HSDB
5. CESARS
6. PP
7. Endosulfan: its effects on environmental quality. NRC Associate Committee of Scientific Criteria for Environmental Quality. Rep. No. 11 (1975). 100 pp.
8. Green, M.B., G.S. Hartley and T.F. West (1977) *Chemicals for Crop Protection and Pest Control*. Pergamon Press: Oxford, New York, Toronto. 290 pp.
9. McLeese, D.W. and C.D. Metcalfe (1980) Toxicities of eight organochlorine compounds in sediment and seawater to *Crangon septemspinosa*. *Bull. Environ. Contam. Toxicol.* 25: 921-928.
10. Vettorazzi, G. (1975) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO Expert Committee on pesticide residues. I. Organohalogenated pesticides used in agriculture and public health. *Residue Reviews*, 56: 107-134.
11. Ernst, W., P. Jonah, K. Doe, G. Julien, and P. Hennigar. (1991) Toxicity to Aquatic Organisms of Off-Target Deposition of Endosulfan applied by Aircraft. *Environmental Toxicology and Chemistry* 10: 103-114.

EPTC

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — EPTC (BSI, E-ISO, F-ISO, WSSA, JMAF)

[ii] TRADE NAME — Eptam, Eradicane (Zeneca Agro)

[iii] CHEMICAL NAME — *S*-ethyl dipropylthiocarbamate

[iv] CAS # — 759-94-4

[v] TYPE / MODE OF ACTION — Selective systemic carbamate herbicide. Absorbed by roots and shoots with translocation to the leaves and stems.[1]

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Particularly effective for control of annual grasses and nutgrass, and perennial weeds such as quackgrass. Also effective on a number of broadleaf weeds. For use in potatoes, beans, forage legumes, alfalfa, clover, peas, flax, sugar beets, almonds, castor beans, citrus, corn, grapes, lespedeza, ornamentals, pine nurseries, safflower, snap dragons, sunflowers, sweet potatoes, table beets, tomatoes, trefoil, and walnuts. EPTC is more effective against grasses than broadleaves. It is not effective as a contact herbicide. Compatible with other pesticides including metribuzin.

[i] APPLICATION — Applied pre-plant prior to weed germination. May also be applied post-emergence in potatoes.[5] If EPTC is applied to extremely dry soil during very dry climatic conditions, incorporation may be accomplished by overhead irrigation following application. In treating crops such as citrus and deciduous orchards, alfalfa, clover, etc., which can be flood or sprinkler irrigated, EPTC has given excellent results when metered into the irrigation water. May be applied through sprinkler irrigation systems to a number of crops.[3] For optimum weed control under normal soil and climatic conditions, EPTC must be mechanically incorporated into the soil to a depth of 5-10 cm immediately after application. The most suitable types of equipment for incorporation are discs and hooded, power driven rotary tillers.

[ii] RATES — Corn, 3.4-6.8 kg a.i./ha. Potatoes, 3.4-4.4 kg a.i./ha. Legumes, 3.4 kg a.i./ha.[5]

CARRIER: Water or liquid fertilizer.

[iii] FORMULATIONS

1. GR
2. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Apparently indefinite storage life under normal ambient conditions. Photosensitivity is indeterminate. Non-corrosive. No incompatibilities known or expected. Not affected by freezing. EC formulations can be stored at temperatures as low as - 45°C.[5]

4. HANDLING PRECAUTIONS

Do not apply before pre-irrigation. Do not use on blackeye beans, soybeans, lima beans, and other flat podded beans. Corn is injured if planted deeper than 5 cm. Do not move untreated soil into the incorporated area.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — At recommended rates of application, EPTC does not persist in the soil, and should not leave residues that could injure subsequently planted sensitive crops. Microbial decomposition is the main mechanism of loss from soil. Reported field half-lives range from 6-32 days.[7] The half-life in moist loam soil at 21-27°C is approximately 1 week.

Rapidly undergoes microbial degradation to a mercaptan residue, an amino residue, and carbon dioxide.[1] EPTC is readily lost from soil by volatilization when soil surface is wet at the time of application.[4]

[ii] AQUATIC — Volatilization is expected to be the major fate process (Half-life ~2.4 days in a model river).[6] Hydrolysis and bioconcentration are not expected to be significant.

[iii] ATMOSPHERIC - If released to air EPTC will exist solely in the vapor-phase in the ambient atmosphere. Vapor-phase EPTC will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 14 hrs.[6]

[iv] PHYTODEGRADATION — Rapidly metabolized to carbon dioxide and naturally occuring metabolites.[7]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1632 mg/kg		7
Rat	LD_{50} dermal	>2000 mg/kg		1
Rat	NOEL 90d	16.0 mg/kg/d		1
Mouse	LD_{50} oral	3160 mg/kg		7
Mouse	NOEL 2y	20.0 mg/kg/d		1
Rabbit	LD_{50} oral	2640 mg/kg		7
Rabbit	LD_{50} dermal	5000 mg/kg		7
Dog	NOEL 90d	20.0 mg/kg/d		1
Bobwhite quail	LC_{50} dietary 7d	20000 mg/kg diet		1
Rainbow trout	LC_{50} 96h	19.0 mg/L		2
Cutthroat trout	LC_{50} 96h	17.0 mg/L	Static bioassay	6
Lake trout	LC_{50} 96h	16.0 mg/L		7
Bluegill sunfish	LC_{50} 96h	14.0 mg/L		1
Blue crab	LC_{50} 24h	>20.0 mg/L	Technical grade	4
Gammarus fasciatus	*LC_{50} 96h*	*66.0 mg/L*		*6*
Daphnia	*EC_{50} 48h*	*14.0 mg/L*		*1*

[i] TOXICITY (OTHER) — Non-toxic to bees (LD_{50} 0.011 mg/bee).[1] Slightly toxic to birds and fish. Does not cause sensitization in guinea pig.[4] Non-teratogenic, non-muutagenic, does not appear to be carcinogenic.[7]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In rats, low amounts of EPTC are eliminated mainly by expired air, with much smaller amounts eliminated via urine and faeces.[7]

[ii] PLANT – In plants, EPTC is rapidly metabolized to CO_2 and other metabolites.[1]

8. ADDITIONAL INFORMATION

In true solution, formulations are rapidly hydrolyzed under alkaline conditions but are largely protected by their low solubility.[8] Use higher rates on peat and muck soils. Established plants tolerate over-the-top spray application. Non-corrosive to metal or rubber. Applied in the irrigation water to a number of crops. May be applied in pre-plant soil incorporated in the fall to sugar beets grown in the Red River Valley prior to the time ground freezes.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. PMRA
6. HSDB
7. PP
8. Green, M.B. , G.S. Hartley and T.F. West (1977) *Chemicals for Crop Protection and Pest Control*. Pergamon Press: Oxford, New York, Toronto. 290 pp.

Ergocalciferol

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — calciferol (BAN); ergocalciferol ergocalciferol(INN); Vitamin D2.

[ii] TRADE NAME — Sorexa C.R. (Sorex Ltd.)

[iii] CHEMICAL NAME — (5*Z*,7*E*,22*E*)-(3*S*)-9,10-secoergosta-5,7,10(19),22-tetraen-3-ol

[iv] CAS # — 50-14-6

[v] TYPE / MODE OF ACTION — An organic compound used as a rodenticide. Calciferol is a natural vitamin, but is lethal at high doses. It promotes high absorption of calcium and reabsorbs it into the bone tissues, causing high calcium levels.[2] Hypervitaminosis is characterized by these high calcium levels, as well as an increase in serum cholesterol.[1] Rodents undergo a rapid appetite decline by the second day.[2]

[vi] NOTICE – Sorexa, the only registered product for this active, is **being discontinued with last date of sale being December, 2005.**

2. USE PATTERN

Used as a multiple feeding rodenticide. Can be used in combination with warfarin.

[i] APPLICATION — Apply at frequent intervals where rodents congregate. Maintain baits on a regular basis.

[ii] RATES — 1-2 feeds is generally sufficient to cause death.

CARRIER: Feed bait.

[iii] FORMULATIONS

1. SL
2. PT

[iv] SUGGESTED AQUATIC SET BACKS:

1.	Ground application:	Not identified.
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

This chemical has a shelf-life in excess of 2 years.[2] Compatible with other rodenticides; stable in alkaline media; unstable to light and air, and in acidic media.[1] Storage with inert gas improves stability.[3] Capsules, oral solution and tablets should be stored in tight, light resistence containers at a temperature less than 40°C, preferably between 15-30°C.[3] Ergocalciferol injection should be protected from light and stored at a temperature less than 40°C, preferably between 15-30°C.[3]

4. HANDLING PRECAUTIONS

Not identified.

5. ENVIRONMENTAL PERSISTENCE

Calciferol is degraded by direct sunlight.[2]

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD oral	56.0 mg/kg		1
Mouse	LD^{50} oral	23.7 mg/kg		1
Rat	LD$^{50}_{50}$ oral 5d subacute	7.0 mg/kg/d		1

[i] TOXICITY (OTHER) — Relatively safe to domestic animals. Low toxicity, unless it is consumed over a period of time in large amounts.[2]

[ii] PHYTOTOXICITY - Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

None identified.

6. REFERENCES

1. PM
2. AC
3. HSDB

Ethephon

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — ethephon (ANSI, Canada); chorethephon (New Zealand)

[ii] TRADE NAME — Base 250, Ethrel (Aventis CropScience Canada Co.); *Nu-tomatotone (Rhone-Poulenc Canada Inc.)*

[iii] CHEMICAL NAME — 2-chloroethylphosphonic acid

[iv] CAS # — 16672-87-0

[v] TYPE / MODE OF ACTION — Organic phosphorus compound used as a growth regulator.

2. USE PATTERN

Depending on plant species, chemical concentration, and time of application to one or more growth sites (roots, buds, leaves, stems, flowers, fruit), ethylene release produces numerous physiological effects and can be utilized to regulate various phases of plant metabolism, growth, and development. Used on apples, blueberries, bromeliads, cantaloupes, cherries, coffee, cranberries, cucumbers, squash, figs, filberts, lemons, peppers, pineapples, rubber, tangerines, tobacco, tomatoes, walnuts. Used in fruit storage rooms to hasten ripening of bananas, citrus, melons, pears, and pineapples and also to induce flowering of pineapple plants.[5] Used to prevent fruit set of certain ornamentals such as apples, crabapples, carob, and olives.[3]

[i] RATES — PINEAPPLE PLANTS: 1.0 kg/2000 L or half this concentration. PINEAPPLE FRUITS: 2.2 kg/ha at 200 g/100 L. TOMATO FRUITS (pre-harvest): 875 g/ha at 200 g/100 L or half this concentration. APPLES: 24.0-48.0 g/ 100 L. PEACHES: 864 g/ha at 200 g/100 L. BULB ONIONS: 500 L spray/ha in 280 g a.i./ 100 L.

CARRIER: Solution.

[ii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

2.	Ground application:	Calculated: 0 m
3.	Air blast application:	Not identified.
4.	Aerial application:	Not identified.
5.	Forestry application:	Not identified.

3. STORAGE

Corrosive (pH 0.8). Dilute aqueous solutions slowly decompose. Stable at pH 3 but decomposes at higher pH values. Non-flammable. Incompatible with alkaline materials and with solutions containing metal ions, *e.g.*, iron-zinc-, copper-, and manganese-containing-fungicides.[1]

4. HANDLING PRECAUTIONS

Do not apply to diseased, low vigour, or moisture stressed trees. Avoid drift. Do not graze treated areas. Do not allow mixed solution to stand overnight. Use as soon as possible after mixing with water. Gloves and eye shield advised.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Major routes of dissipation appear to be chemical hydrolysis and microbial degradation; degrades in somewhat acidic soils (pH 6.1). Moderate to low mobility in soil.[6]

[ii] AQUATIC – Does not hydrolyze in sterile, acidic water.[6]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	4229 mg/kg		2
Rat	NOEL 2y F.T.	<3000 mg/kg diet	No increase in carcinomas	1
Human	ADI	0.05 mg/kg b.w.		1
Mallard	LC_{50} 8d	10,000 mg/kg diet		4
Bobwhite	LD_{50} oral	1000 mg/kg		1
Bluegill sunfish	LC_{50} 96h	300 mg/L		1
Rainbow trout	LC_{50} 96h	350 mg/L		1
Daphnia	*EC_{50} 48h*	*>500 mg/L*		*1*

[i] TOXICITY (OTHER) — Dermal and eye irritant; strongly acidic. Non-toxic to bees and earthworms.[1] Slightly toxic to mammals. Minimal effects expected on birds, mammals, fish, freshwater invertebrates, and marine and estuarine organisms.[6]

[ii] PHYTOTOXICITY — Extremely high rates are generally phytotoxic. Some gummosis of cherry trees and leaf drop in walnuts has occured.

7. METABOLISM

[i] ANIMAL – Ethepon is rapidly excreted intact via the urine, and as ethylene via the expired air.[1]

[ii] PLANT – Ethepon rapidly undergoes degradation to ethylene.[1]

8. ADDITIONAL INFORMATION

Incompatible with alkaline salts. Growth regulation properties appear due to the ability to release ethylene into plant tissues. Plant response depends on climatic conditions and so rates recommended may vary with area and country.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. Green, M.B., G.S. Hartley and T.F. West (1977) *Chemicals for Crop Protection and Pest Control*. Pergamon Press: Oxford, New York, Toronto. 290 pp.
6. USEPA. 1995. R.E.D. Facts: Ethephon. Prevention, Pesticides and Toxic Substances. EPA-738-F-95-004, April.

Ethion

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — ethion (BSI, E-ISO, F-ISO, ANSI, ESA, JMAF); diethion (France, Rep. of South Africa); exception (Italy, Portugal)

[ii] TRADE NAME — Later's Ethion (Later Chemicals Ltd.); *Greenleaf (Greenleaf Garden Supplies).*

[iii] CHEMICAL NAME — *O,O,O′,O′*-tetraethyl *S,S′*-methylene bis(phosphorodithioate)

[iv] CAS # — 563-12-2

[v] TYPE / MODE OF ACTION— A phosphorodithioate compound used as a non-systemic organophosphorus insecticide.

[vi] NOTICE — In Canada, the only registered ethion product is Later's Onion Maggot Control with sale of the product discontinued December 31, 2001. **Registration and use of the product is to be discontinued as of December 31, 2003**. US EPA published a cancellation order for all ethion products. As of December 31, 2004, the manufacturing, sale, and use of all ethion products will be prohibited in the United States.

2. USE PATTERN

This soil insecticide is specifically made to control onion maggots. Use when seeding or transplanting onions.

[i] APPLICATION — Apply as either a dormant or foliar spray. Thorough coverage is necessary. Granules may not be used in the furrow at onion planting time to control onion maggot.

[ii] RATES — 0.25-1.0 g/L water or 4.4-5.6 kg/ha.

CARRIER: Water.

[iii] FORMULATIONS

1. GR
2. WP
3. EC
4. PP
5. Various oil solutions and combinations with other materials.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Slowly oxidized in air, and hydrolyzed by acid and alkalis. Non-corrosive; non-flammable. Incompatible with alkaline materials.[1] Shelf life is 2 years; unstable at elevated temperatures.[6]

4. HANDLING PRECAUTIONS

Do not combine with lime or copper (except in oil formulations), or with zinc sulphate plus lime. Skin should be washed thoroughly with soap and water when contaminated by ethion and routinely after work. Protective clothing each time it is contaminated, as well as routinely removed before going home. Smoking and eating should be prohibited in ethion work areas. Use and handling of ethion should not be conducted by persons with diseases of the respiratory system, cardiovascular system, CNS, liver, kidney, or eyes.[6]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Moderately to highly persistent in soil. Half-lives range from 1.3 to 8 weeks under laboratory conditions to 16 to 49 weeks in greenhouses with organic soil.[7] Subject to microbial degradation. Adsorbs strongly to soil particles and is nearly insoluble in water; unlikely to leach or contaminate groundwater.[7]

[ii] AQUATIC – Almost insoluble in water; half-life varied between 4 and 22 weeks.[7] Photooxidation may occur in sunlight.[7]

[iii] ATMOSPHERIC – Ethion undergoes oxidation in air slowly and is subject to acid and base hydrolysis.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	6340 mg/kg	Females	1
Rat		0.3 mg/kg/d	No effect levels, based on ChE inhibition studies and 2 year ChE activity studies (plasma, brain, erythrocyte)	4
Female albino rat	28d F.T.	300 mg/kg diet	No effect on growth rate but evidence of ChE inhibition at 10 mg/kg diet	2
Mouse	LD_{50} oral	4000 mg/kg		1
Rabbit	LD_{50} dermal	915 mg/kg		2
Dog		0.05 mg/kg/d	No effect levels, based on ChE inhibition studies and 2 year ChE activity studies (plasma, brain, erythrocyte)	4
Human		0.05 mg/kg/d	3 week exposure; no-effect level on plasma ChE	4
Human	ADI	0.006 mg/kg		3
Hen	LD_{50} oral	4000 mg/kg		1
Rainbow trout	LC_{50} 96h	66.0 mg/L		1
Daphnia	*EC_{50} 48h*	*53.0 mg/L*		*1*

[i] TOXICITY (OTHER) — Cholinesterase inhibitor. Results of dominant lethal test in mice, teratogenicity test in rats, and neurotoxicity test in hens are all negative. Toxic to fish and birds. May be absorbed through skin. Toxic to bees.[1]

[ii] PHYTOTOXICITY — Non-phytotoxic when used as directed except to apple varieties maturing at the same time as or earlier than Early McIntosh.

7. METABOLISM

[i] ANIMAL — Oxygen analogues do not occur with emulsifiable formulations. Studies made following feeding to dairy cattle showed small amounts of ethion (but no oxygen analogues) in milk and fatty tissues. Poultry do not have residues either in body fat or in eggs after eating feed containing small amounts of ethion. Metabolised in animals by oxidation to a phosphorothioate, followed by dealkylation and hydrolysis.[1]

[ii] PLANT — Foliar application of wettable powder can give rise to small amounts of ethion monooxan and ethion dioxon, usually less than 20% of total residue.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council. 1987. 1081 pp.
3. Pesticide Res. food. Annex I, pp. 354.
4. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO Expert Committee on pesticide residues. II.Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews* 63: 1-44.
5. CESARS
6. HSDB
7. PP

Etridiazole

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — etridiazole (BSI, E-ISO, F-ISO); echlomezol (JMAF)

[ii] TRADE NAME — Truban (Mallinckrodt Canada Inc); *Wilson's Etridiazole (Wilson Laboratories Inc.)*

[iii] CHEMICAL NAME — 5-ethoxy-3-(trichloromethyl)-1,2,4-thiadiazole

[iv] CAS # — 2593-15-9

[v] TYPE / MODE OF ACTION — A soil drench fungicide.

2. USE PATTERN

Control of *Pythium, Phytophthora, Fusarium, Rhizoctonia*, damp off, and root and stem rots.

[i] APPLICATION — ORNAMENTALS: Soil drench or dry soil mix for potted plants. Apply at time of seeding or transplanting. Water immediately. Repeat at 1-3 month intervals.

[ii] RATES — 450-900 g a.i. in 2500 L water/ha, 0-43.0 kg actual/ha or 0.79-0.12 kg actual/ 50 kg of seed.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. EC
3. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 11 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Stable; no loss of activity during 3 years of storage under normal conditions. Miscible with ethanol, methanol, aromatic hydrocarbons, acetonitrile, hexane, and xylene.[1] Hydrolyzed on contact with alkali media.[6] Do not use or store near food, foodstuffs, open heat or flame.[7]

4. HANDLING PRECAUTIONS

Eye protection equipment should be worn.[6] Repeated contact may be harmful. Do not use on crops to be used for food; do not use on sensitive plants. Do not contaminate domestic irrigation or recreational waters or apply substance directly to water, or clean equipment or dispose of wastes in waterbodies that could be contaminated. Do not mix with other pesticides or fertilizer.[7] Avoid breathing dust or spray mist; avoid contact with skin, eyes and clothing. Wash thoroughly with soap and water after handling. Wash clothing after handling and application. Do not allow pets or children in treated areas during application.[7]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – If released to soil, etridiazole is expected to have low mobility. Volatilization from moist soil surfaces is expected to be an important fate process. etridiazole is not expected to volatilize from dry soil surfaces based upon its vapor pressure. Biodegradation is expected to be an important fate process in the environment based upon a half-life of 7 days observed in a field study using a sandy clay loam. The hydrolysis half-life is 103 days at pH 6 and 25 deg C, suggesting that hydrolysis will occur slowly in moist soils and water.[6]

[ii] AQUATIC – If released into water, etridiazole is expected to adsorb to suspended solids and sediment based upon the estimated K_{oc}. Volatilization from water surfaces is expected to be an important fate process. Estimated volatilization half-lives 1 and 20 days, respectively.[6]

[iii] ATMOSPHERIC – If released to air etridiazole will exist solely as a vapor in the ambient atmosphere. Vapor-phase etridiazole will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 56 hours.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	4000 mg/kg	Koban formulation	2
Rat	LD$_{50}$ oral	1077 mg/kg		2
Mouse	LD$_{50}$ oral	2000 mg/kg		3
Rabbit	LD$_{50}$ dermal	1700 mg/kg		2
Bobwhite quail	LD$_{50}$ oral	560 mg/kg		1
Rainbow trout	LC$_{50}$ 96h	0.77ppm		5
Rainbow trout	LC$_{50}$ 24h	>4.0 mg/L		1
Daphnia	*EC$_{50}$ 48h*	*4.9 mg/L*		*1*

[i] TOXICITY (OTHER) — May cause skin irritation. Toxic to fish.[7]

[ii] PHYTOTOXICITY — Soil drenches more phytotoxic than soil mixes. Generally non-phytotoxic when used as directed

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Do not mix with other pesticides or fertilizers. Most effective in *Pythium* spp.; less effective on *Rhizoctonia* than PCNB, but more effective on other soil-borne diseases. Provides both curative and preventative control. Four consecutive autumn treatments (*i.e.*, over 4 years) of etridiazole caused no change in nitrogenase activities, nitrogen mineralization and denitrification capacities, and nitrification of ammonium.[4]

9. REFERENCE

1. PM
2. FCH
3. AC
4. Rodgers, G.A. (1987) Biological nitrogen transformations in soil after repeated application of nitrification inhibitors. *Zentralbl. Mikrobiol.* 142: 343-348.
5. ECOTOX
6. HSDB
7. PMRA. Truban, Scotts Sierra Crop Protection Company.

Fenitrothion

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — fenitrothion (BSI, E-ISO, F-ISO, ESA, BAN); MEP (JMAF)

[ii] TRADE NAME — Sumithion (Sumitomo Chemical Co Japan); *Novathion (A/S Cheminova Denmark); Folithion (Chemagro Ltd).*

[iii] CHEMICAL NAME — *0,0*-dimethyl *0*-4-nitro-*m*-tolyl phosphorothioate

[iv] CAS # — 122-14-5

[v] TYPE / MODE OF ACTION — Broad spectrum organophosphorus insecticide (phosphorothioate). Acts as a contact insecticide and selective acaricide with low ovicidal activity.

[vi] NOTICE — Fenitrothion is **currently under re-evaluation** in Canada. The US EPA has developed mitigation measures to reduce exposure of the acutely toxic fenitrothion. These measures include: outdoor use fenitrothion products classified as restricted use, use on Christmas tree plantations voluntarily withdrawn, establishment of baseline personal protective equipment requirements for handlers of end-use products.

2. USE PATTERN

Used almost world-wide for controlling chewing and sucking insects on crops such as rice, fruits, vegetables, cereals, soybeans, coffee and tea. Used in public health and on farms as residual spray for mosquito, fly and cockroach control. Somewhat effective against mites. Used on forest trees. Provides control of the larval stages of spruce budworm, eastern hemlock looper, western hemlock looper, sawflies, cankerworm, jackpine budworm, and spruce budmoths infesting forests, woodlots, tree nurseries, and Christmas tree plantations.

[i] APPLICATION — Thorough coverage necessary. Apply by ground and aerial sprays when insects first appear, and repeat as necessary. Fenitrothion is fast-acting.[3]

[ii] RATES — 0.05-0.075% active or 0.14-2.2 kg a.i./ha. Aerial: 1.42 L/ha.

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. SN
3. LI
4. WP
5. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 24-30 m
2. Air blast application:	Not identified.
3. Aerial application:	Label: 400 m upwind, 100 m downwind
4. Forestry application:	Calculated: >1000 m

3. STORAGE

Hydrolyzed by alkali (Half-life ~3 days at pH 11, <24 hrs at pH 13).[4] This product is combustible. Keep away from heat, sparks, or open flame. Keep container closed when not in use. Do not contaminate food or feed, or any waterways. Keep unauthorized and unprotected people out of loading and mixing zones. If prolonged storage is anticipated, container should be protected from rain and snow. Fenitrothion does not need to be protected from freezing temperatures.

4. HANDLING PRECAUTIONS

Unprotected workers should not enter fields for at least 48 hours following treatment.[3] This product is harmful if swallowed, inhaled, or absorbed through the skin. Avoid contact with eyes or skin. Do not breath vapours. When handling insecticide concentrate (*i.e.*, pumping and mixing or loading), rubber boots, rubber suit or apron, rubber gloves, a respirator, goggles, and a hat should be worn. Wash hands, arms, and face frequently with soap and water throughout the operation and before eating or smoking.

5. ENVIRONMENTAL PERSISTENCE

Residual effect in plants lasts 4-5 days.[13] On mud or wood walls relatively persistent; residual effect on mud walls lasts 3-6 months (applied at 2.0 g/m^2).[5] Not persistent in forest environments except in conifer foliage.[9] In river water, decomposition is accelerated by anaerobic bacteria under non-aerated conditions.[13] Stable in sterilized soil, suggesting that microorganisms (prob. fungi) play important role in decomposition.[13] *Bacterium subtilis* degrades fenitrothion to aminofenitrothion. Fungi apparently not involved in breakdown.[9] Rapid photodecomposition by UV light in air.[13] Volatilization plays an important role in the disappearance of fenitrothion.[7,8]

[i] SOIL — Under upland conditions, half-life is 12-28 days at 25°C, depending on soil type; major products are CO_2 and 3-methyl-4-nitrophenol. In submerged soils decomposition is more rapid.[13] Not significantly eluted from top 3 cm of soil except in sand with low organic matter and clay content.[13]

[ii] AQUATIC — In river water with sediment, half-life is approximately 50 hours (aerated), 30-40 hrs (non-aerated) (2.5-10.0 µg/L).[13] Hydrolyzed at pH >7 but more persistent under acid conditions; half-life is 60 hours at pH 5.42, 22 hours at pH 8.22. [9] Half-life in pond and stream water samples is 0.3-3.5 days. [9]

[iii] ATMOSPHERIC — Not identified.

[iv] PHYTODEGRADATION — Half-life in and on fruit is 1-3 days. Gradually hydrolyzed to p-nitrocresol and conjugated with glucose.[13] May persist in coniferous foliage >1 year.[9] Decomposed with half-lives of 0.6-1.0 days in distilled water, 1.5, 1.0 and 0.9 in buffer solution at pH 3, 7, and 9, respectively. Decomposed with a half-life of 0.9-1.1 days in natural river and sea water.[6]

[v] OTHER — Not identified.

6. TOXICITY

Fenitrothion is converted by oxidases to the active fenitrooxon in mammals, plants, and insects.

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1700 mg/kg	Males	1
Rat	LD_{50} dermal	810 mg/kg	Males	1
Rat	LD_{50} dermal	1300 mg/kg		2
Rat	NOEL 2y	10.0 mg/kg diet		1
Dog	NOEL 1y	50.0 mg/kg diet		1
Dog		0.125 mg/kg/d	No effect level	11
Human	ADI	0.003 mg/kg		7
Quail	LD_{50} oral	23.6 mg/kg		1
Mallard	LD_{50} oral	1190 mg/kg		1
Bluegill sunfish	LC_{50} 96h	3.8 mg/L		1
Rainbow trout	LC_{50} 96h	2.4 mg/L	Fenit/ Arotex Atlox/ water	19
Rainbow trout	LC_{50} 96h	1.8 mg/L	Technical grade	20
Rainbow trout	LC_{50} 96h	1.7 mg/L	Technical grade	21
Rainbow trout	LC_{50} 96h	2.2 mg/L	Flowable	21
Fathead minnow	LC_{50} 96h	3.2 mg/L	Technical grade	18
Fathead minnow	LC_{50} 96h	2.4 mg/L	Liquid	18
Fathead minnow	LC_{50} 96h	4.2 mg/L	Wettable powder	18
Brook trout	LC_{50} 96h	1.7 mg/L		1
Carp	LC_{50} 48h	4.1 mg/L		1
Cutthroat trout	LC_{50} 96h	2.88 mg/L		12
Stickleback	LC_{50} 96h	3.1 mg/L	Flowable & liquid technical formulas	22
Mystus cavasius	*LC_{50} 96h*	*3.3 mg/L*	*Technical grade*	*14*
Labeo rohita	*LC_{50} 96h*	*2.8 mg/L*	*Technical grade*	*14*
Cyprinus carpio	*LC_{50} 24h*	*4.0 mg/L*		*15*
Clarius batrachus	*LC_{50} 96h*	*10.5 mg/L*	*EC_{50}*	*16*
Tilapia mossambica	*LC_{50} 48h*	*6.0 mg/L*	*EC_{50}*	*17*
Ictalurus punctatus	*LC_{50} 96h*	*4.3 mg/L*	*Technical grade*	*18*
	LC_{50} 96h	*8.6 mg/L*	*Liquid*	*18*
	LC_{50} 96h	*5.1 mg/L*	*Wettable powder*	*18*
Lepomis macrochirus	*LC_{50} 96h*	*1.0 mg/L*	*Technical grade*	*18*
	LC_{50} 96h	*0.7 mg/L*	*Liquid*	*18*
	LC_{50} 96h	*1.4 mg/L*	*Wettable powder*	*18*
Salmo salar	*LC_{50} 24h*	*4.4 mg/L*	*Technical grade*	*22*
	LC_{50} 48h	*2.7 mg/L*	*Technical grade*	*22*
	LC_{50} 96h	*0.9 mg/L*	*Technical grade*	*22*
Culex tarsalis	*LC_{50} 24h*	*0.4 μg/L*		*23,24*
Acroneuria sp.	*LC_{50} 24h*	*2.0 μg/L*		*23,24*
Eriocera spinosa	*LC_{50} 24h*	*40.0 mg/L*		*23,24*
Brachycentrus numerosus	*LC_{50} 24h*	*20.0 mg/L*		*23,25*
Molluscs	*LC_{50} 96h*	*5.2-29 mg/L*	*Flowable & liquid technical formulas*	*22*
Stonefly	*LC_{50} 96h*	*4.3 (pH 6.5)-8.8 (pH 7.5) μg/L*		*12*
Daphnia magna	*EC_{50} 48h*	*0.0076 and 1.0103 mg/L*	*Flowable & liquid technical formulas*	*22*

[i] TOXICITY (OTHER) — Readily absorbed through the skin.[1] Skin irritant.[26] Cholinesterase inhibitor. Much lower acute mammalian toxicity than many similar insecticides. Injection of fenitrothion into White Leghorn eggs at 5-30% concentration (0.1 mL col) caused visible abnormalities such as dwarfism, curled toe, leg weakness, and abnormal gait.[8] Highly toxic to honey bees. Causes a significant reduction in pollinator populations, which in commercial blueberry fields take several years to recover. There is evidence that this chemical poses a considerable risk to migratory songbirds. Causes significant invertebrate mortality (up to 50%) in large ponds.[4] Toxic to fish, but fish are able to metabolize fenitrothion. Fenitrothion is an acetylcholinesterase inhibitor. Effects of exposure to fenitrothion to fish result in biochemical, histopathological, reproductive and behavioural changes. Test for mutagenicity and two reproduction studies in rats showed no adverse effects at doses below those toxic to parents. No delayed neurotoxicity in hen, no carcinogenicity.

[ii] PHYTOTOXICITY — Some photodecomposition in crucifer vegetables and certain apple varieties.[5] Some injury has been reported on alfalfa and sorghum.[3] Non-phytotoxic when used as recommended. Cotton, brassicas and some fruits may be injured by high rates of application. Russeting is possible with some apple varities.[1]

7. METABOLISM

[i] ANIMAL – Experiments have shown that it is rapidly degraded in mammals to several metabolites which are readily excreted in the urine and faeces and are rarely detected in milk. Orally administered fenitrothion is rapidly absorbed from the gastrointestinal tract of rats or guinea pigs. Liver homogenate is capable of transforming fenitrothion into water soluble compounds if it is fortified with NADPH and reduced gluthione. Orally administered fenitrothion is rapidly excreted. *S*-methyl isomer (impurity in tech. prod. 0.5-1%) is a much more potent anti-ChE but more rapidly metabolized than parent compound.[13] No tendency for fenitrothion or its metabolites to accumulate in animal tissues following approved uses on pasture or forage crops.[13] Fenitrothion bioaccumulates in fish, although residues are usually cleared within one day.[4] Relatively non-toxic to red-backed voles due to the rapid detoxication by two mechanisms cleaving fenitrothion at the P-O-aryl and P-O-alkyl bonds, the latter becoming more prominent at higher dose levels.[10]

[ii] PLANT - Several metabolites known in plants and include desmethyl fenitrothion, aminofenitrothion, 3-methyl-4-nitrophenol. Latter is major metabolite in plants and animals (low toxicity indicated).

8. ADDITIONAL INFORMATION

Harmful to bees so do not spray flowering crop. Spray immediately if mixed with alkaline compound. Fast cleanup with long residual action. Good penetrative action. Considered as effective as parathion but much safer to handle. Compatible with most other pesticides.

9. REFERENCES

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3. AC
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26. HSDB

Fenthion

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — fenthion (BSI, E-ISO, F-ISO, ESA, BPC); MPP (JMAF)

[ii] TRADE NAME — Tiguvon, Spotton, Lysoff, *Entex* (Bayer Inc.); *Baytex (Mobay Chemical Corp.)*

[iii] CHEMICAL NAME — *O,O*-dimethyl *O*,4-methylthio-*m*-tolyl phosphorothioate

[iv] CAS # — 55-38-9

[v] TYPE / MODE OF ACTION — Organophosphorus insecticide (phosphorothioate group).

[vi] NOTICE — The **only uses registered in Canada are for lice/parasite control on beef cattle and non-lactating dairy cattle** (pour on applications). In the U.S., uses on livestock were discontinued by registrants.

2. USE PATTERN

Contact and stomach insecticide with useful penetrant and persistent action. TIGUVON and SPOTTON: controls cattle grubs, and lice. LYSOFF: controls lice

[i] APPLICATION — LIVESTOCK: spray, pour-on, or back rubber.

[ii] RATES — 0.5-1.0 mL a.i./100kg body weight.

CARRIER: Water.

[iii] FORMULATIONS

1. PP
2. EC
3. GR
4. SU
5. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Subject to hydrolysis. Stable $\leq 210^{\circ}$, to light and to alkali. Relatively stable in acidic conditions.[1]

4. HANDLING PRECAUTIONS

Avoid excessive wetting of plastic, tile, rubber, etc. Do not apply as space spray. Do not apply to young, stressed, or sick animals. Do not apply for mosquito control in areas containing fish, shrimp, crabs, or crayfish. Incompatible with insecticides and fungicides which are highly alkaline.[1]

5. ENVIRONMENTAL PERSISTENCE

Has given control of insects in stored products from 4-16 months. Gave 100% control of mosquitoes after 42 weeks when applied to sides of barns.

[i] SOIL – The degradation of fenthion occurs rapidly under aerobic conditions, forming the metabolites fenthion sulfoxide, fenthion sulfone, followed by the analogous phenol compounds.[1]

[ii] AQUATIC – More rapidly degraded under alkaline conditions.[6]

[iii] ATMOSPHERIC – If released to the atmosphere, fenthion will degrade rapidly in the vapor-phase by reaction with photochemically produced hydroxyl radicals (half-life of about 5 hr).[7]

[iv] PHYTODEGRADATION — Oxidized to sulphone and sulphoxide, both insecticidal.[1]

[v] OTHER — Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	250 mg/kg		2
Rat	LD$_{50}$ oral	125 mg/kg	Sulphone	5
Rat	LD$_{50}$ oral	125 mg/kg	Sulphoxide	5
Rat	LD$_{50}$ dermal	c. 2000 mg/kg		2
Rat		0.15 mg/kg/d	No effect levels	4
Dog		0.05 mg/kg/d	No effect levels	4
Dog	NOEL 1y	2.0 mg/kg diet		1
Human		0.0005 mg/kg	ADI (temporary) based on apparently unusual effect on ChE activity and lack of long-term feeding studies (WHO/FAO 1972b, p. 119)	4
Bobwhite quail	LD$_{50}$ oral	7.2 mg/kg		1
Mallard	LC$_{50}$ dietary 5d	1259 mg/kg		1
Rainbow trout	LC$_{50}$ 96h	0.87 mg/L		1
Bluegill sunfish	LC$_{50}$ 96h	1.6-1.7 mg/L		1
Daphnia	*EC$_{50}$ 48h*	*5.2-5.7 µg/L*		*1*

[i] TOXICITY (OTHER) — More toxic to fowl than to mammals. Highly toxic to birds.[6] Toxic to bees and aquatic life. Cholinesterase inhibitor. Signs of intoxication from a single oral dose develop slowly, persist for a long time, and are not readily alleviated by atropine or by most common oxime reactivators. Does not appear to accumulate in the body. Not teratogenic,reproductive effects unlikely in humans.[6]

[ii] PHYTOTOXICITY — Considered non-phytotoxic at recommended rates. Do not apply to hawthorn, American Linden, sugar maple or the rose variety Delightful. Some injury has occured to certain varieties of apples and cotton.

7. METABOLISM

Slowly absorbed, metabolized by a complex series of reactions, and excreted. In most instances the unhydrolyzed metabolites containing a P atom are more toxic than the parent compound.[4]

[i] ANIMAL – Following oral administration, excretion is mainly in the form of hydrolysis products in the urine. Major metabolites are fenthion sulfoxide, fenthion sulfone and their oxygen analogues. These metabolites are hydrolysed in further degradation, forming the corresponding phenols.[1]

[ii] PLANT – Fenthion is oxidized to the sulfoxide and sulfone, both of which possess insecticidal properties, and to the monodesmethyl compound of fention sulfoxide. Further degradation occurs to the sulfone phosphate, which undergoes hydrolysis.[1]

8. ADDITIONAL INFORMATION

Believed compatible with most insecticides and fungicides except alkaline materials. Residual effectiveness even on alkaline surfaces.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO meeting on pesticide residues. II. Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews*, 63: 1-44.
5. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
6. PP
7. HSDB

Fenvalerate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — fenvalerate (BSI, E-ISO, F-ISO, ESA)

[ii] TRADE NAME — Bovaid, *Belmark* (Ciba-Geigy Canada Ltd.)

[iii] CHEMICAL NAME — (*RS*)-a-cyano-3-phenoxybenzyl (*RS*)-2-(4-chlorophenyl)-3-methylbutyrate

[iv] CAS # — 51630-58-1

[v] TYPE / MODE OF ACTION — Broad spectrum pyrethroid insecticide with stomach and contact action.[1]

2. USE PATTERN

Highly active, non-systemic insecticide effective against a broad range of pests, including strains resistant to organochlorine, organophosphorous and carbamate insecticides. Used in ear tags.

[i] APPLICATION — Apply to entire herd in early spring.

[ii] RATES — 1-2 eartags/animal.

CARRIER: Eartags.

[iii] FORMULATIONS

1. SR
2. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Not identified.
2. Ari blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Stable in sunlight; resistant to rain wash-off. High thermal stability; relatively non-volatile. Stable to moisture and in most organic solvents except alcohols. Incompatible with alkaline materials.[1] Store in original container away from foodstuffs and animal feed.[7]

4. HANDLING PRECAUTIONS

Store in original containers away from food and feed. Avoid contact with mouth, skin, and eyes. While handling, wear protective gloves, impervious clothing and goggles or full face shield. Wash skin promptly with soap and water when contamination occurs. Wash clothes daily and immediately upon contamination.[7]

5. ENVIRONMENTAL PERSISTENCE

If released to soil or water, fenvalerate can degrade through biodegradation, photodegradation and aqueous hydrolysis. Screening studies have suggested that biodegradation is the primary route of degradation. Photodegradation may become the major degradation route on terrestrial surfaces (soil, plants, etc.) or shallow waters exposed to sunlight. Aqueous hydrolysis may become important when the medium pH exceeds 8.[7]

[i] SOIL — Average half-life of 6 weeks in 0-2.5 cm soil layer. Not readily leached downwards. Minimal lateral movement.[6] Heat labile factors (probably micro-organisms) more important than purely physical or chemical degradation.[5] Fenvalerate is not expected to leach in soil.[7] Fenvalerate is reported to have half-lives of 1 to 18 days on soil surfaces, 15 days to 3 months within soil systems and 8 to 14 days on plants.[7]

[ii] AQUATIC – In aquatic ecosystems, fenvalerate is expected to partition from the water column to sediment and suspended matter. Half-life of 4 to 15 days in natural water.[7]

[iii] ATMOSPHERIC – If released to the atmosphere, fenvalerate will degrade rapidly in the vapor phase by reaction with photochemically produced hydroxyl radicals (estimated half-life ~10 hours).[7]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	451 mg/kg	DMSO	2
Rat	LD_{50} oral	>2670 mg/kg	Gold Crest Tribute	2
Rat	LD_{50} dermal	>5000 mg/kg	DMSO	2
Rat	NOEL 2y	250 mg/kg diet		1
Rabbit	LD_{50} dermal	>2500 mg/kg	DMSO	2
Human	ADI	0.02 mg/kg bw/day		1
Mallard	LD_{50} oral	9932 mg/kg		1
Domestic fowl	LD_{50} oral	>1600 mg/kg		1
Rainbow trout	LC_{50} 96h	3.6 μg/L		1
Carp	LC_{50} 48h	0.1 mg/L		1
Bluegill	LD_{50} 48h i.p.	0.670 mg/kg	Technical grade	4
Bluegill	LD_{50} 48h i.p.	0.120->260 mg/kg	Other isomers	4

[i] TOXICITY (OTHER) — May be irritating to eyes and skin. Toxic to fish and bees. Low toxicity to mammals.[7] No teratogenic or mutagenic activity.[7]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as recommended.

7. METABOLISM

[i] ANIMAL – Following oral administration, fenvalerate is rapidly metabolized. Up to 96% is excreted in the faeces within 6-14 days.[1] Elimination from body fat is slow, with a half-life of 7-10 days; elimination from brain is less slow, with a half-life of 2 days.[7]

[ii] PLANT – The majority of the acids and phenols formed through metabolization are converted into glucosides.[1]

8. ADDITIONAL INFORMATION

Residual control with fast knockdown. In one study, fenvalerate was highly toxic to the predatory mite *Typhlodromus pyri*, Non-toxic to prey spider mite *Panonychus ulmi* on apples (pre-bloom spray); this led to spider mite population increase later in season.[3]

8. REFERENCES

1. PM
2. FCH
3. Aliniaze, M.T. and J.E. Crauham (1980) Effect of four synthetic pyrethroids on a predatory mite, *Typhlodromus pyri*, and its prey, *Panonychus ulni*, on apples in Southeast England, *Environ. Entomol.* Vol 9: pp 436-439.
4. Bradbury, S.P. *et al.* (1987) Toxicity of fenvalerate and its constituent isomers to the Fathead minnow, *Pimephales promelas* and Bluegill, *Lepomis macrochirus*. *Bull. Environ. Contam. Toxicol.*, 38: 727-735.
5. Chapman, R.A., C.M. Tu, C.R. Hanis and C. Cole (1981) Persistence of 5 pyrethroid insecticides in sterile and natural, mineral and organic soil. *Bull. Env. Contam. Toxicol.* Vol 26: pp. 573-579.
6. Hill, B.D. (1981) Persistence and distribution of fenvalerate residues in soil under field and laboratory conditions. *J. Agric. Food Chem.* Vol 29: pp. 107-110.
7. HSDB

Ferbam

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — ferbam (BSI, E-ISO, JMAF); ferbame (F-ISO); exception (FRG)

[ii] TRADE NAME — Chipman's Ferbam (Chipman Inc.); Pfizer's Ferbam (Pfizer C and G Inc.); Wilson's Ferbam (Wilson Laboratories Inc.)

[iii] CHEMICAL NAME — iron tris(dimethyldithiocarbamate)

[iv] CAS # — 14484-64-1

[v] TYPE / MODE OF ACTION — Carbamate compound used as a foliar fungicide.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Principal uses include the control of apple scab, cedar apple rust, and tobacco blue mold. Applied as a protective fungicide to many other fruit and vegetable crops and ornamentals.

[i] APPLICATION — Apply uniformly getting thorough coverage. Keep foliage and fruit covered during infection periods. A spreader-sticker should be used on hard to wet foliage.

[ii] RATES — 1.1-16.8 kg a.i./ha or 1.0-3.0 g a.i./L water.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. SU
3. DU
4. SG
5. WG

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 14-29 m
2.	Air blast application:	Calculated: 14(23)-30(40) m
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

It is somewhat unstable to heat and moisture and should be kept away from ignition sources because the decomposition products are flammable. Stable to storage in closed containers, decomposes upon prolonged storage.[1]

4. HANDLING PRECAUTIONS

A black spray residue is left on the crop which should be removed by washing, stripping, etc. Incompatible with lime, copper, or mercury compounds, as efficiency is reduced when mixed with these compounds. Do not use immediately before or after a basic copper sulphate application. Wear appropriate protective clothing and equipment to prevent contact with skin and eyes.[4] Recommended dress: safety glasses or goggles, rubber gloves, waterproof boots, long-sleeved shirt, long pants and hat.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL - In soil, ferbam is expected to have moderate mobility. Under acidic conditions, it will almost completely degrade within 4 to 5 weeks; under neutral conditions, it will require 14 to 15 weeks to degrade. Ferbam will biodegrade in soil with a half life of 8 weeks.[4]

[ii] AQUATIC - Ferbam is not expected to volatilize from water surfaces. It may hydrolyze under acidic conditions.[4]

[iii] ATMOSPHERIC – If released to the atmosphere, ferbam will exist as an aerosol and will be removed from the air physically through dry and wet deposition.[4]

[iv] PHYTODEGRADATION – Notidentified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>4000 mg/kg		1
Rat	NOEL 2y	250 mg/kg diet		1
Mouse	14d	23.0 mg/kg	9% dead	
Mouse	14d	228 mg/kg	10% dead	
Dog	NOEL 2y	5.0 mg/kg/d		1
Human	ADI	0.02 mg/kg b.w.		1
Fowl	7 weeks	205 mg/kg b.w.		
Guppy	96h	90μg/L		3
Channel catfish	LC_{50} 27h	12.6 mg/L		
Longnose killifish	LC_{50} 24h	1.0 mg/L		
Oyster	*96 hours*	*0.075 mg/L*	*50% decrease in shell growth*	

[i] TOXICITY (OTHER) — Irritating to nose and throat. Non-toxic to bees.[1]

[ii] PHYTOTOXICITY — Generally non-phytotoxic but black spray residue may be objectionable. May cause russeting in Golden Delicious apples.[2]

7. METABOLISM

[i] ANIMAL - Not stored in body tissues.[1]

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

Compatible with common insecticides and fungicides including oils. Acts as a repellent toward Japanese beetles.[2]

9. REFERENCES

1. PM
2. AC
3. ECOTOX
4. HSDB

Fluazifop-butyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — fluazifop (BSI, E-ISO, F-ISO, ANSI)

[ii] TRADE NAME — Fusilade, Fusilade 2 (Zeneca Limited)

[iii] CHEMICAL NAME — (*RS*)-2-[4-(5-trifluoromethyl-2-pyridyloxy)phenoxy]propionic acid.

[iv] CAS # — 069806-50-4

[v] TYPE / MODE OF ACTION — A selective post-emergence herbicide.

[vi] NOTICE — **Only technical is registered in Canada.**

2. USE PATTERN

For the control of grass weeds in broad-leaved crops such as soybean, alfalfa, fruit, tobacco, ornamental trees, and many vegetables. At low rates, it controls annual and seedling perennial grasses. At higher rates, it controls mature perennials.

[i] APPLICATION — Systemic herbicide. Must be applied post-emergence, when weeds are in the 2-4 leaf stage.[2] Two applications are sometimes required. Apply to johnsongrass when 30-46 cm tall. Do not use if rainfall is expected within one hour. Do not mix with other pesticides.[2] Do not apply by aircraft. Use with crop oil concentrate.

[ii] RATES — 0.063-2.0 kg a.i./ha, depending on weed susceptibility, in 100-300 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

2. Ground application: Calculated: 0 m
3. Air blast application: Not identified.
4. Aerial application: Not identified.
5. Forestry application: Not identified.

3. STORAGE

This product is not affected by temperatures below 0°C. It is stable in storage at temperatures as high as 50°C. Should not be stored near open flame. Reasonably stable in acidic and neutral conditions, but rapidly hydrolysed in alkaline media (pH 9).[1]

4. HANDLING PRECAUTIONS

Use skin and eye protection when handling concentrate. Women of child-bearing age should be particularly careful when handling this chemical, as it may cause birth defects. Wear coveralls, boots, nitrile (liquid proof) gloves, and safety goggles when handling concentrated product. Avoid spray mist. Wash thoroughly with soap and water after handling and before eating or smoking. Avoid drift onto other crops and non-target areas. Do not apply by aircraft. Corn, cereals, and turf are highly susceptible to Fusilade 2. With come herbicides, crop damage may be increased and the effectiveness of fluazifop-butyl may be reduced.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — This is a slow acting chemical which remains active in the soil and can affect susceptible crops sown up to 4 months after application of high rates (2.0 kg/ha). The biological activity persists longer in light, sandy soils. It undergoes rapid hydrolysis, especially in saturated soils. (*i.e.*, at 100% field saturation capacity 97% of chemical is gone after 24 hours; at 20% field saturation capacity only 6% is gone after 24 hours).[4] The major degradation product is fluazifop. [3]Fluazifop-butyl is rapidly degraded in moist soils, with a half-life of less than 1 week. The product of degradation is fluazifop which in turn has a half-life in soils of about 3 weeks. Susceptible rotation crops can be planted 60 days after fluazifop-butyl treatments are applied.[3] Persistence in soil is lengthened by cold and dry conditions.[1]

[ii] AQUATIC – If released into water, this compound is expected to adsorb strongly to suspended solids and sediment in the water column based on its estimated K_{oc}. Volatilization from water surfaces is not expected to be an important fate process. The potential for bioconcentration in aquatic organisms is very high based on an estimated BCF of 1500. Hydrolysis half-lives of 2.2 years and 79 days have been estimated for fluazifop-butyl at pHs 7 and 8, respectively. Abiotic hydrolysis of fluazifop-butyl has been observed to be catalyzed by soil colloids.

[iii] ATMOSPHERIC – If released to the atmosphere it will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase fluazifop-butyl will be rapidly degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 13 hours. Particulate-phase fluazifop-butyl may be physically removed from the atmosphere by wet and dry deposition.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>2000 mg/kg	Males	1
Mouse	LD_{50} oral	1490 mg/kg	Males	1
Guinea pig	LD_{50} oral	2659 mg/kg	Males	1
Mallard	LD_{50} oral	>17,000 mg/kg		1
Rat	LD_{50} dermal	>6050 mg/kg		1
Rabbit	LD_{50} dermal	>2420 mg/kg		1
Dog	NOEL 1y F.T.	5.0 mg/kg/d	No toxicological effects noted	1
Rat	NOEL 90d . F.T.	100 mg/kg diet		1
Mouse	NOEL 2y F.T.	5.0 mg/kg diet		1
Mallard	LC_{50} dietary 5d	>25,000 mg/kg		1
Pheasant	LC_{50} dietary 5d	>18,500 mg/kg		1
Rainbow trout	LC_{50} 96h	1.37 mg/L		1
Mirror carp	LC_{50} 96h	1.31 mg/L		1
Bluegill	LC_{50} 96h	0.53 mg/L		1

[i] TOXICITY (OTHER) — Low toxicity to honeybees, both orally and by contact. Moderately toxic to fish. Mild skin and eye irritant, not a skin sensitizer.[6] Teratogenic, causes birth defects in rats.

[ii] PHYTOTOXICITY — All broadleaf crops are tolerant.[2]

7. METABOLISM

[i] ANIMAL — Although residues of up to 2.0 mg/kg are permitted in rapeseed and soybean meal, significant residues are unlikely to appear in the meat or milk of livestock consuming such meal.[5] Metabolised in rats to form fluazifop, which is not further metabolsied.[1]

[ii] PLANT — In plants, fluazifop-butyl is absorbed through the leaf surface, and is rapidly hydrolyzed to fluazifop.[3]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. AC
3. HH
4. Smith, A.E. (1987) Persistence studies with the herbicide fluazifop-butyl in Saskatchewan soils under laboratory and field conditions. *Bull. Environ. Contam. Toxicol.*, 39: 150-155.
5. CAPCO Note, 07/31/1987. Canada 87-12. Agriculture Canada Food Production and Inspection Branch, Pesticides Directorate, 6 pp.
6. HSDB

Folpet

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — folpet (BSI, draft E-ISO, draft F-ISO, ANSI, JMAF); folpel (France)

[ii] TRADE NAME — Phaltan (Chevron Ltd.); Folpan (Makhteshim-Agan); Nuodex (Nuodex Canada Ltd.); Wilson's folpet (Wilson Laboratories Inc.); C-I-L Rose Dust (Nu-Gro IP Inc.); Later's Folpet (Later Chemicals Inc.)

[iii] CHEMICAL NAME — *N*-(trichloromethylthio)phthalimide

[iv] CAS # — 133-07-3

[v] TYPE / MODE OF ACTION — Protective foliar fungicide and material preservative.

2. USE PATTERN

Controls apple scab, cherry leaf spot, rose black spot, and rose mildew. Used on fruits, berries, vegetables, flowers, and ornamentals. Used for seed and plant bed treatment.[3] Fungal control in paints, plastics, adhesives, textiles, paper, etc. Used as a post-harvest spray on sour cherries.[3]

[i] APPLICATION — Apply as a spray at specified intervals covering new growth as it appears. Continue through the growing season.[3] Can be added to water or to aqueous systems.

[ii] RATES — 75.0-560 g a.i./100 L in up to 200 L water/ha; 10.0 kg/ha; 0.25-1.0% by weight as a preservative.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. PP
3. DU
4. SU
5. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground applications:	Calculated: 8-14 m
2. Air blast applications:	Calculated: 6(14)-8(17) m
3. Aerial applications:	Not identified.
4. Forestry applications:	Not identified.

3. STORAGE

Non-corrosive, but decomposition products are corrosive. Slowly hydrolyzed by water at room temperature, rapidly by alkali or at higher temperatures. Stable in the dry state.[1]

4. HANDLING PRECAUTIONS

Do not mix with strong alkali. Do not mix with, or apply following, an oil spray. Do not combine with TEPP. Do not use wetting agents on roses. Do not combine with EC formulated insecticides.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL - If released to soil, folpet is expected to have very high mobility based upon a K_{oc} of 21.9. Volatilization from moist soil surfaces is not expected to be an important fate process. Folpet is not expected to volatilize from dry soil surfaces based upon its vapor pressure. Based on aquatic studies, folpet undergoes rapid chemical hydrolysis with half-lives ranging from 2.6 hours at pH 5 to 67 seconds at pH 9. Hydrolysis products include phthalimide, phthalamic acid and phthalic acid. In soil metabolism studies, folpet had measured half-lives of 2 to 3 days.[10]

[ii] AQUATIC — Slowly hydrolyzed by water, rapidly concentrated by alkali. If released into water, folpet is not expected to adsorb to suspended solids and sediment based upon its K_{oc} value. Hydrolysis is a major fate process for this compound. Volatilization from water surfaces is not expected to be an important fate process.[10]

[iii] ATMOSPHERIC – If released to air folpet will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase folpet will be degraded in the atmosphere by reaction with photochemically-produced

hydroxyl radicals; the half-life for this reaction in air is estimated to be 1.02 days. Particulate-phase folpet will be removed from the atmosphere by wet and dry deposition.[10]

[iv] PHYTODEGRADATION — Residues remaining in strawberries and grapes at harvest time are very low (0-0.041 mg/kg in strawberries, <0.01-0.5 mg/kg in grapes).[4] In greenhouse tomatoes, only a very small amount enters plant cuticles, therefore the amount on the surface is effectively reduced by dilution and mechanical removal.5

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>10,000 mg/kg		2
Rat		160 mg/kg/d	No effect	7
Mouse	LD_{50} oral	10,000 mg/kg		7
Mouse	LD_{50} intraperitoneal	20.0 mg/kg		7
Rainbow trout	LC_{50} 96h	146ppb		8
Rainbow trout	LC_{50} 96h	0.185 mg/L		9
Dog		1000 mg/kg/d	No effect	7
Human	ADI	0.01 mg/kg		1

[i] TOXICITY (OTHER) — Toxic to fish.[3] May be irritating to mucous membranes; contact with skin and eyes or inhalation of dust or spray mist may be locally irritating. No significant effect on reproductive performance observed in rats over 3 generations at 1000 mg/kg diet; no teratogenic effect in monkeys, hamsters, and rats.[1] Treatment of male mice by Bateman's dominant lethal procedure did not induce dominant lethal mutations. Rats survived oral administration of 10,000 mg/kg. Non-toxic to earthworms or bees.[1] Highly toxic to most aquatic animal species tested.[10]

[ii] PHYTOTOXICITY — Non-phytotoxic except to D'Anjou pears, and sweet cherries. Can produce russeting of sensitive apple varieties (Golden Delicious, Red Delicious, Stayman Winesap) if applied early in cropping (4-6 weeks after bloom). Snapdragons, peaches, and some varieties of grapes have shown injury during extended dry periods.[3]

7. METABOLISM

Main degradation mechanisms thought to be the same as for captan. Dicarbonyl portion of captan forms imides, pthalamic acids, and dicarboxylic acids. Wide range of sulphur-containing compounds found. Volatile products formed (*e.g.*, carbonyl sulphide and thiophosgene).[6]

[i] ANIMAL – Major metabolites are phthalimide, phthalic acid and phthalamic acid.[1]

[ii] PLANT - Major metabolites are phthalimide, phthalic acid and phthalamic acid.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Gilvydis, D.M. *et al.* (1986) Residues of Captan and Folpet in strawberries and grapes. *J. Assoc. Off. Anal. Chem.*, 69: 803-806.
5. El-Zemaity, M.S. (1988) Residues of Captan and Folpet on greenhouse tomatoes with emphasis on the effect of storing, washing and cooking on their removal. *BECT*, 40: 74-79.
6. WHO (1975) 1974 Evaluations of some pesticide residues in food. WHO Pesticide Residue Series, No. 4. 545 pp.
7. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
8. ECOTOX
9. U.S. Environmental Protection Agency. June, 1987. Pesticide Fact Sheet Number 215: Folpet. US EPA, Office of Pesticides and Toxic Substances, Office of Pesticide Programs, Washington, DC.
10. USEPA. 1999. R.E.D. Facts: Prevention, Pesticides and Toxic Substances. EPA-738-F99-016, September.

Formetanate hydrochloride

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — formetanate hydrochloride (BSI, E-ISO, F-ISO, ANSI, ESA)

[ii] TRADE NAME — Carzol (Aventis CropScience Canada Co.)

[iii] CHEMICAL NAME — 3-dimethylaminomethyleneaminophenyl methylcarbamate

[iv] CAS # — 23422-53-9

[v] TYPE / MODE OF ACTION — A carbamate compound used as a contact insecticide and acaricide.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Effective for control of mites, thrips, lygus bugs, white apple leafhopper, spotted tentiform leafminer, and carsperse stink bug on pome and stone fruits and alfalfa grown for seed.[4] Aphids are not controlled.[3]

[i] APPLICATION — Apply when mites or insects appear and repeat as necessary. Thorough coverage is necessary. May be applied by ground equipment or aircraft.[4]

[ii] RATES — 1.0-2.5 kg a.i./ha

CARRIER: Water.

[iii] FORMULATIONS

1. SP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: 2(3) m
3. Aerial application:	Calculated: 0 m
4. Forestry application:	Not identified.

3. STORAGE

Store in a cool, dry place. Store separately from food or feed. Compatible with most commonly used insecticides and fungicides except lime and Bordeaux mixture. Stable for at least 8 years at room temperature. Decomposes at approximately 200°C.[1]

4. HANDLING PRECAUTIONS

Do not use in waters above pH 8.0. Do not spray when rain is expected. Do not mix with alkaline pesticides and do not prepare more spray than will be used within 4 hours. Do not allow livestock to graze treated areas.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL - This chemical rapidly degrades in soil under aerobic conditions. It appears to leach in soil and is thus a potential groundwater contaminant. Expected to be mobile and have medium to high soil mobility.[6]

[ii] AQUATIC – If released to water, formetanate hydrochloride will be essentially non-volatile. Aqueous base-catalyzed hydrolysis of formetanate hydrochloride has an estimated half-life of 4.5 days at pH of 8 and 45.2 days at pH of 7.[6]

[iii] ATMOSPHERIC – If released to the atmosphere, formetanate hydrochloride will exist primarily in the particulate phase. Physical removal from air can occur through wet and dry deposition.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	14.8-26.4 mg/kg		1
Rat	LD_{50} dermal	>5600 mg/kg		1
Rat	NOEL 2y	0.37 mg/kg/d		1
Rabbit	LD_{50} dermal	>10200 mg/kg		2
Dog	LD_{50} oral	19.0 mg/kg		1
Dog	NOEL 1y	10.0 mg/kg diet		1
Hen	LD_{50} oral	21.5 mg/kg		1
Mallard	LD_{50} oral	12.0 mg/kg		1
Mallard	LC_{50} dietary 5d	2086 mg/kg diet		1
Bobwhite quail	LC_{50} dietary 5d	3963 mg/kg diet		1
Rainbow trout	LC_{50} 96h	4.42 mg/L		1
Bluegill	LC_{50} 96h	2.76 mg/L		1
Black bullhead	LC_{50} 96h	75.0 mg/L		5
Daphnia	*EC_{50} 48h*	*0.093 mg/L*		*1*

[i] TOXICITY (OTHER) — Toxic to birds and other wildlife. Moderately toxic to bees.

[ii] PHYTOTOXICITY — Injury has been reported on peas, beans, soybeans, eggplant, cucumbers, and certain rose varieties at high rates of application.[3]

7. METABOLISM

[i] ANIMAL — Eliminated in urine and faeces. The major metabolic pathway involves hydrolysis to metabolites and subsequent formation of the glucurnide and ethereal sulphate conjugates of *m*-acetamidophenol.[4]

[ii] PLANT — Absorbed into the leaves but not translocated. On fruit, weathering and growth dilution appear to be the primary cause of dissipation.[4]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
5. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
6. HSDB

Fosamine ammonium

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — fosamine ammonium (BSI, E-ISO, F-ISO, ANSI, WSSA)

[ii] TRADE NAME — Krenite (E.I. Dupont de Nemours and Company)

[iii] CHEMICAL NAME — ammonium ethyl carbamoylphosphonate

[iv] CAS # — 25954-13-6

[v] TYPE / MODE OF ACTION — Carbamate compound used as post-emergence growth regulator/contact herbicide. It is the ammonium salt of fosamine.

2. USE PATTERN

Brush control agent/growth regulator. Controls bud growth in most woody species in non-crop areas. Used for control of bindweed, bracken fern, and conifer release in forestry.

[i] APPLICATION — FOLIAR SPRAY: Apply within 2 months of leaf senescence in the fall.[2] For suppression with minimum bud effect, make an application during leaf expansion in the spring. Only the portion of the plant sprayed will be affected. May be applied by air.[2] Not effective when applied to the soil.[3] Recommended with the addition of a non-toxic surfactant.[3]

[ii] RATES — 2.4-21.6 kg a.i./500-3370 L water/ha. Higher rates may be used on large plants, dense growth, or hard to control species.

CARRIER: Water.

[iii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

2. Ground application:	Calculated: 0 m
3. Air blast application:	Not identified.
4. Aerial application:	Not identified.
5. Forestry application:	Not identified.

3. STORAGE

Aqueous formulations and spray tank solutions are stable but dilute (50.0 g/L) solutions are subject to decomposition under acidic conditions.[1] Non-flammable and non-volatile.

4. HANDLING PRECAUTIONS

Do not use on food or feed crops.[2] Avoid drift to desirable tree species. If it rains within 24 hours of application, effectiveness may decrease. Do not apply to brush in standing water.[2]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Rapidly decomposed in soil by micro-organisms. Not persistent under aerobic or anaerobic conditions, mobile in most soils.[4] Under field conditions half-life in the soil is c. 7-10 days.[1] By 3-6 months it disappears completely from the soil. In a greenhouse, fosamine ammonium had a half-life of 10 days.

[ii] AQUATIC – May be found in surface waters with low microbiological activities or long hydrological residence times.[4]

[iii] ATMOSPHERIC – If released to the atmosphere, fosamine-ammonium will degrade rapidly in the vapor phase by reaction with photochemically produced hydroxyl radicals (Half-life ~7.9 hr). Particulate phase fosamine-ammonium will be removed physically from air by wet and dry deposition.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg		1
Rat	NOEL 90d F.T.	1000 mg/kg diet	No ill-effects	1
Guinea pig	LD_{50} oral	7380 mg/kg		3
Rabbit	LD_{50} dermal	>1683 mg/kg		1
Mallard	LD_{50} oral	>4150 mg/kg	Formulated product	1
Bobwhite quail	LD_{50} oral	>4150 mg/kg	Formulated product	1
Bluegill sunfish	LC_{50} 96h	278 mg/L		1
Rainbow trout	LC_{50} 96h	>415 mg/L		1
Daphnia	*EC_{50} 48h*	*1524 ppm*		*1*

[i] TOXICITY (OTHER) — Non-irritating to skin or eyes in rabbits. Populations and species of soil bacteria and fungi not affected at 10.0 mg/kg.[3] Safe to fish and wildlife. Non-toxic to bees.[1] Teratogenic to avian embryos.[5]

[ii] PHYTOTOXICITY — Phytotoxic symptoms occur when applied to new growth in the spring, but not when applied in the summer or fall. Conifers are tolerant after the end of shoot growth and formation of terminal buds.[1]

7. METABOLISM

[i] ANIMAL – In one study, 79% was eliminated from the body unchanged, while 13% was hydrolytically degraded to (^{14}C) CPA. The remaining unextractable radioactivity was bound to faeces residue presumably as fosamine.

[ii] PLANT - Not identified

8. ADDITIONAL INFORMATION

Plants treated in summer or fall will not show symptoms until the following spring when they will not leaf out. May be applied with a surfactant.

9. REFERENCES

1. PM
2. AC
3. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
4. RED
5. HSDB

Fosetyl-Al

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME —fosetyl-Al (aluminum salt of fosetyl [BSI, E-ISO, F-ISO])

[ii] TRADE NAME — Aliette (Rhone-Poulenc Canada Inc.)

[iii] CHEMICAL NAME — aluminum *tris* (*O*-ethyl phosphonate)

[iv] CAS # — 39148-24-8

[v] TYPE / MODE OF ACTION — Systemic fungicide with protective and curative action. Absorbed through roots and leaves, inhibits spore germination and mycelium development.[1]

2. USE PATTERN

Used to control Phycomycetes such as *Phytophthora* on fruit crops, ornamentals, ginseng, tobacco, lettuce, and vine crops. Most effective as a preventative treatment. Incompatible with foliar fertilizers.[1]

[i] APPLICATION — Foliar sprays and drench treatments can be used, but the foliar application is the only recommended method for bearing apple trees.[2] Ground application only.

[ii] RATES — APPLES: Foliar, 2.4-4.0 kg a.i./ha (depending on tree density). Drench, 4.0-8.0 g a.i./tree. GINSENG: 4.8 kg a.i./ha in 200 L water.[2]

CARRIER: Water at a volume no greater than 1000 L/ha.

[iii] FORMULATIONS

1. WG
2. WP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 15 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable under normal storage conditions.[3] Products left exposed to air will absorb moisture over time and become unusable. Hydrolysis of foseytl-aluminum occurs under extreme acid or alkaline conditions; incompatible with foliar fertilizers.[1]

4. HANDLING PRECAUTIONS

Maximum of three applications per year in apples.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL - Low persistence in soil (Half-life ~20 min.-1.5 h).[1] Extremely short half-life under both aerobic and anaerobic conditions with rapid dissipation and metabolism.[1]

[ii] AQUATIC – Since fosetyl-aluminum is stable in water, susceptible to leaching, and stable to decomposition by water, may leach to ground water in cases where unexpected heavy rainfall closely follows foliar application of the pesticide.[4]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	5800 mg/kg		1
Rat	NOEL 90d	5000 mg/kg diet		1
Mouse	LD_{50} oral	3700 mg/kg		1
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Dog	NOEL 90d	50000 mg/kg diet		1
Bobwhite quail	LD_{50} oral	>8000 mg/kg		1
Rainbow trout	LC_{50} 96h	428 mg/L		3
Fiddler crab	LC_{50} 96h	145 mg/L		1
Daphnia	*EC_{50} 96h*	*189 mg/L*		*1*

[i] TOXICITY (OTHER) —In animals, fosetyl-Al is almost completely absorbed and is metabolized to carbon dioxide and phosphoric acid.[1] Non-toxic to worms and other beneficial species.[1] Non-teratogenic and non-mutagenic.

[ii] PHYTOTOXICITY - Non-phytotoxic.

7. METABOLISM

[i] ANIMAL – Fosetyl-aluminum is almost completely absorbed and undergoes extensive metabolic transformation, the major end-products being CO_2 and phosphorous acid.[1]

[ii] PLANT – The metabolism of fosetyl-aluminum in plants proceeds through the hydrolytic cleavage of the ethyl ester bond. Phosphorous acid is detected as the major metabolite.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. PMRA
3. HSDB
4. USEPA. 1991. R.E.D. Facts: Fosetyl-Al. Prevention, Pesticides and Toxic Substances. 738-F-90-100, January.

Glyphosate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — glyphosate (BSI, E-ISO, F-ISO, ANSI, WSSA, JMAF)

[ii] TRADE NAME — Round-Up, Rustler, Vision, Mocan, (Monsanto Canada Inc.); Glyfos (Cheminova Canada); Touchdown (Zeneca Agro); Erase; *Clear it, Side Kick (1,2 and 3).*

[iii] CHEMICAL NAME — *N*-(phosphonomethyl)glycine

[iv] TYPE / MODE OF ACTION — An aliphatic acid used as a broad spectrum systemic herbicide. Interferes with the formation of amino acids and other endogenous chemicals.[1]

2. USE PATTERN

For control of most perennial weeds in non-cropland, fallowland, rangeland, pasture, and shelterbelts. It is also used in orchards, vineyards, and pre-tillage or post-harvest on cropland for control of many annual and deep rooted perennials. Experimentally used on all broadleaved brush species. Used for site preparation and as a directed spray for tree plantings and nurseries. Glyphosate may also be used as an aquatic herbicide,[2] but has not been registered for this use in Atlantic Canada since 1993.

[i] APPLICATION — Apply as a post-emergence spray to foliage of vegetation to be controlled. Higher volumes may be necessary for heavy, tall, and dense foliage to assure adequate spray coverage of understory vegetation. Use low pressures (no higher than 275 kpa) and suitable nozzles to avoid small droplets which could lead to spray drift and injury of nearby susceptible plants. For good results in perennial weed control, plants should be treated at full maturity, or with at least 4-8 leaves to allow translocation. Annuals are controlled regardless of growth stage.

[ii] RATES — Annuals, 0.27-1.23 kg a.i./ha. Perennials, 0.89-4.27 kg a.i./ha. [4]

CARRIER: Water at 50-300 L/ha. Effectiveness of control is reduced with large quantities of water.[2]

[iii] FORMULATIONS

1. SN
2. SG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Label: 15 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Froestry application:	Not identified.

3. STORAGE

Formulations of Round-Up are quite stable under temperatures up to 60°C. Will freeze at -29°C, but will go back into solution upon thawing. Non-volatile, will not photochemically degrade and are stable in air; stable to hydrolysis at pH 3,6 and 9.[1]

4. HANDLING PRECAUTIONS

Do not use or store in galvanized or unlined steel spray equipment. Will react with metal to cause a highly combustible gas. Do not mix with dirty water. Avoid spray drift. Handle with care; avoid contact with eyes. Do not use >337 L spray solution/ha. In using around trees do not spray green bark. Mixing with other herbicides may reduce the activity of glyphosate.[1]

5. ENVIRONMENTAL PERSISTENCE

Glyphosate is relatively non-persistent in soil and offers little or no pre-emergent activity; thus it appears that crops can be planted or seeded directly into treated areas following application. The half-life is reported to be 28 days.

[i] SOIL — Binds soil lightly and then is rapidly (Half-life ~60 days) and completely biodegraded into natural products by microorganisms present in soil and water. Sandy soil had 43% dissipation in 112 days; half-life of 130 days. Silt soil had 90% dissipation in 14 days. Silty, clay soil had 90% dissipation after 80 days; half-life is 25 days. The half-life for silt soil is 3 days. Moderate to strong soil adsorption. Very low leaching.3 Soil residues usually near or below 10% of that applied within a growing season.[3] Microbial action is the major cause of degradation in soil. Depending on soil and microflora population types, varying rates of decomposition occur, *e.g.*, 10-60% over growing season time period or less.[3]

[ii] AQUATIC — Rapidly degraded by adsorption and biodegradation (Half-life of a few days). In one study, it was actually decomposed more readily (when exposed to sunlight) in clear deionized water than polluted water, which had a high microbial content.[9]

[iii] ATMOSPHERIC - Glyphosate will be released into the atmosphere as an aerosol during spraying and removed by gravitational settling. It will occur in the atmosphere only as an aerosol and may degrade by photolysis.[5]

[iv] PHYTODEGRADATION — Glyphosate activity on plants is inhibited by several other herbicides. The most antagonistic is atrazine. Others are propazine, simazine, cyanazine. Plants can metabolize glyphosate to give CO_2 and natural organic products.[3]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	5660 mg/kg		1
Rat	LD_{50} oral	4050 mg/kg	Glyphosate-isopropylammonium	1
Rat	LD_{50} oral	748 mg/kg	Glyphosate-trimesium	1
Rat	LC_{50} inhalation (4h)	1.3 mg/L air	Glyphosate-isopropylammonium	1
Rat	NOEL 2y F.T.	300 mg/kg diet	No ill-effects	1
Mouse	LD_{50} oral	1568 mg/kg		6
Rabbit	LD_{50} dermal	>2000 mg/kg	Glyphosate-trimesium	1
Human	ADI	0.3 mg/kg b.w.		1
Dog	NOEL 2y F.T.	300 mg/kg diet	No ill-effects	1
Bobwhite quail	LD_{50} oral	>3850 mg/kg		1
Japanese quail	LC_{50} oral	>5000 ppm		5
Rainbow trout	LC_{50} 24h	140 mg/L		7
Rainbow trout	LC_{50} 96h	130 mg/L		7
Rainbow trout	LC_{50} 96h	(lab) 54.8 mg/L	Avoidance preference data indicate that fish would avoid lethal levels of Round-Up	8
Rainbow trout	LC_{50} 96h	(field) 52.0 mg/L	Avoidance preference data indicate that fish would avoid lethal levels of Round-Up	8
Bluegill sunfish	LC_{50} 24h	230 mg/L		7
Bluegill sunfish	LC_{50} 96h	220 mg/L		7
Channel catfish	LC_{50} 96h	130 mg/L		7
Harlequin fish	LC_{50} 96h	168 mg/L		7
Fiddler crab	LC_{50} 96h	934 mg/L		7
Daphnia	*EC_{50} 48h*	*>780 mg/L*		*1*

[i] TOXICITY (OTHER) — General toxicity to wildlife and fish. Toxicological investigations conducted with bobwhite quail, mallard ducks, honeybees, rainbow trout, bluegills, and other species of fish show that these species have an extremely high tolerance to glyphosate. Its decomposition products are not harmful to soil or water microorganisms. Very low crop selectively. Not mutagenic, not carcinogenic, not teratogenic, not neurotoxic.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – The chemical is not retained in animal tissues. There is essentially no likelihood for high level chronic exposure or accumulation in the food chain to occur.

[ii] PLANT – Slowly metabolized to aminomethylphosphonic acid, which is the major plant metabolite.[1]

8. ADDITIONAL INFORMATION

May be washed off plant foliage by rain, if rain occurs within 6 hours of application. Very broad spectrum, relatively non-selective. Very effective on deep-rooted perennials. Tillage should be delayed 5 days or more to allow chemical to move to the underground parts of the perennial weed. Initial activity is fairly slow and effects may not be observed for several days. Shade slows down the degree of control, but eventually it will be comparable with sunlight conditions. No pre-emergence activity, so a crop may be planted immediately following application.[2]

9. REFERENCES

1. PM
2. AC
3. HH
4. PMRA
5. HSDB
6. CESARS
7. PP
8. Hildebrand, L.D., D.S. Sullivan and T.P. Sullivan (1982) Experimental studies of rainbow trout populations exposed to field applications of Round-Up herbicide. *Arch. Environ. Contam. Toxicol.* 11: 93-98.
9. Lund-Høie, K. and H.O. Friestad (1986) Photodegradation of the herbicide glyphosate in water. *Bull. Environ. Contam. Toxicol.* 36: 723-729.

Hexazinone

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — hexazinone (BSI, E-ISO, F-ISO, ANSI, WSSA)

[ii] TRADE NAME — Velpar, *Pronone* (Dupont Canada Inc.)

[iii] CHEMICAL NAME — 3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1*H*,3*H*)-dione

[iv] CAS # — 51235-04-2

[v] TYPE / MODE OF ACTION — Triazine compound used as a non-selective and post-emergence contact herbicide. Inhibits photosynthesis.

2. USE PATTERN

For control in sugarcane, alfalfa, blueberries, Christmas trees, pasture grasses and non-crop areas. Also being used in conifer-release programs and on forestry seedling planting sites. Control of annual broadleaf and grass seedlings, as well as most annual and perennial grasses, broadleaf weeds, and vines, depending on rates. Also formulated with diuron.

[i] APPLICATION — FOLIAR SPRAY: Post-emergence during periods of active plant growth. May not be effective if applied when vegetation is dormant or semi-dormant. Gives contact and residual control. Rainfall required for soil activation.

[ii] RATES — 4.05-13.3 kg a.i./ha for season long vegetation control.[2] Lowland blueberries, 1.0 kg a.i./ha. Site preparation, 2.0-4.0 kg a.i./ha. [3]

CARRIER: Water.

[iii] FORMULATIONS

1. SN
2. SP
3. GR
4. SG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Label: 50 m
2. Air blast application:	Not identified.
3. Aerial application:	Label: 100 m
4. Forestry application:	Label: 100 m

3. STORAGE

Stable in aqueous solution at pH 5-9 at temperatures of up to 37°C. Decomposed by strong acids and strong alkalis. Stable to light.[1]

4. HANDLING PRECAUTIONS

Do not use near desirable trees or on plants standing in water. Spray concentrations will not dissolve in amounts exceeding 5.0 kg/200 L of water. Prevent drift. Do not use on sandy or coarse-textured soils.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Degraded primarily by microorganisms in the soil with little degradation occurring under sterile or anaerobic conditions.[7] Half-life is 1-12 months depending on soil and weather conditions.[4] Hexazinone is highly mobile in soil and is expected to leach. Concentration is highest at about 205 days at a depth of 30 cm.[6] Persistent and mobile.[9]

[ii] AQUATIC — Degradation is mainly due to photolytic processes. Degrades in water to at least eight transformation products.[8] GROUNDWATER — Has been detected in groundwater near blueberry operations. Photodecomposition, biodegradation, and dilution are the prime mechanisms for loss of hexazinone activity in aquatic systems.[5] Persistent and mobile.[9]

[iii] ATMOSPHERIC – When released into the atmosphere, hexazinone will be lost by gravitational settling. Vapor-phase hexazinone reacts with photochemically-produced hydroxyl radicals with an estimated half-life of 3.6 hr.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1690 mg/kg		1
Rat	NOEL 2y	250 mg/kg diet		1
Guinea pig	LD_{50} oral	860 mg/kg		1
Rabbit	LD_{50} dermal	5278 mg/kg		4
Dog	LD_{50} oral	3400 mg/kg		4
Mallard	LC_{50} dietary 8d	>10000 mg/kg diet		1
Bobwhite quail	LD_{50} oral	2258 mg/kg		1
Bobwhite quail	LC_{50} dietary 8d	>10000 mg/kg diet		1
Rainbow trout	LC_{50} 96h	320-420 mg/L		1
Bluegill	LC_{50} 96h	370-420 mg/L		1
Coho salmon	LC_{50} 24h	290 mg/L		8
Coho salmon	LC_{50} 96h	246 mg/L		8
Chinook salmon	LC_{50} 24h	394 mg/L		8
Chinook salmon	LC_{50} 96h	317 mg/L		8
Fathead minnow	LC_{50} 96h	274 mg/L		1
Daphnia	*LC_{50} 48h*	*151 mg/L*		5

[i] TOXICITY (OTHER) — Relatively harmless to fish and wildlife.[2] Toxic to juvenile Pacific salmonids.[8] Not toxic to bees (LD_{50} >60.0 ug/bee).[1] Non-toxic to birds.[5] Toxic to larch trees and should not be used for weed control in forested areas.[5] Slightly or non-mutagenic.[5]

[ii] PHYTOTOXICITY – Should not be used for weed control in larch or in areas planted with deciduous species.[1]

7. METABOLISM

[i] ANIMAL – Fairly rapidly processed and excreted by animal systems; long-term exposure does not diminish this rapid processing and elimination.[5]

[ii] PLANT – Hexazinone is readily absorbed in the root zone and translocated throughout the plant. It is less mobile following uptake from the foliage. It is converted in non-susceptible plants to less phytotoxic compounds. In susceptible plants, it is more persistent and can result in disruption of photosynthesis and chloroplast damage.[5]

8. ADDITIONAL INFORMATION

More effective the higher the air temperature. Very effective on brush and hard to kill perennial weeds. Water solubility of 30,000 mg/L. Degree and duration of control varies depending on rainfall, temperature, plant species, and application rate. Although weed control from hexazinone treatment often lasts several years, it appears this is a result of good initial kill of weedy vegetation, and not herbicide carry-over.[7]

9. REFERENCES

1. PM
2. AC
3. PMRA
4. HSDB
5. PP
6. Feng, J.C., S.S. Sidhu, C.C. Feng and V. Servant (1989) Hexazinone residues and dissipation in soil leachates. *J. Environ. Sci. Health* B24 [2]: 131-143.
7. Jensen, K.I.N. and E.R. Kimball (1987) Persistence and degradation of the herbicide Hexazinone in soils of Lowbush Blueberry fields in Nova Scotia, Canada. *BECT* 38: 232-239.
8. Wan, M.T., R.G. Watts and D.J. Moul (1988) Evaluation of the acute toxicity to juvenile Pacific salmonids of hexazinone and its formulated products: Pronone 10G, Velpar® L and their carriers. *BECT* 41: 609-616.
9. USEPA. 1994. R.E.D. Facts: Hexazinone. Prevention, Pesticides and Toxic Substances. EPA-738-F-94-019, September.

Hydramethylnon

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — hydramethylnon (BSI, ANSI, draft E-ISO); hydramethylnone (draft F-ISO)

[ii] TRADE NAME — Impact Ant Control System, Maxforce Roach Control System (Clorox Co. of Canada Ltd.); Combat Ant (Clorox Co. of Canada Ltd.)

[iii] CHEMICAL NAME — 5,5-dimethylperhydropyrimidin-2-one 4-trifluoromethyll-a-(4-=trifluoromethylstyryl) cinnamylidenehydrazone

[iv] CAS # — 67485-29-4

[v] TYPE / MODE OF ACTION — Non-systemic insecticide with stomach action.[1] Slow acting stomach poison so it may be conveyed to the nest by worker ants to kill the queen.

2. USE PATTERN

For control of arthropods and molluscs. Also controls agricultural and household ants and cockroaches.

[i] APPLICATION — place bait stations in areas not accessible to children but near areas where cockroaches typically live, feed, or travel. These areas include dark, warm, and damp places usually found in kitchens, bathrooms, and basements, in corners and along edges, in cabinets, closets, on shelving, and under appliances and furniture. Bait should also be placed wherever food is available to cockroaches (around food containers, near crumbs, and around garbage).

[ii] RATES — Use 12 bait stations per 20 m^2 of surface (including shelf surfaces) to be treated. Replace all bait stations every 2-3 months to maintain control.

CARRIER: Bait stations.

[iii] FORMULATION

1. SO
2. PA

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Keep out of reach of children and pets. Do not contaminate food or feed. When stored in original unopened container, stable in excess of 24 months at 25 °C, 12 months at 37°C, and 3 months at 45°C. Undergoes photolysis in sunlight.[1]

4. HANDLING PRECAUTIONS

When placing bait stations, keep out of reach of children and pets. May be harmful if swallowed. Do not remove bait from stations. Avoid contamination of food or feed. Do not place directly over food, utensils, dishes, or food preparation areas. Do not contaminate water through improper disposal. Discard used containers in the garbage. Never place bait stations in broad, open areas.

5. ENVIRONMENTAL PERSISTENCE

Little hazard expected under field conditions because of low solubility in water.

[i] SOIL – Rapidly degraded in sunlight by photolysis. Half-life in sandy loam is approximately 7 days; half-life when incorporated in sandy loam is approximately 28 days. Formulated bait decomposes rapidly in daylight. Not mobile and does not leach. Low bioaccumulation potential.[1] Stable to abiotic hydrolysis and photodegradation on soil.[4]

[ii] AQUATIC – Due to its very low water solubility, it is not likely to be found in surface waters.[3] In water, hydramethylnon is expected to adsorb very little to sediment or particulate matter based on its K_{oc} value. This compound may be expected to volatilize from water surfaces. Estimated volatilization half-lives are 37 - 278 days.[5]

[iii] ATMOSPHERIC – If released into the atmosphere, hydramethylnon is expected to exist predominantly in the particulate phase in the ambient atmosphere. Vapor phase hydramethylnon is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals with a half-life of about 2.7 hours.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1131 mg/kg	Males	1
Rat	LD_{50} oral	1300 mg/kg	Females	1
Rabbit	LD_{50} dermal	>5000 mg/kg		2
Mallard	LD_{50} oral	>2510 mg/kg		1
Bobwhite quail	LD_{50} oral	1828 mg/kg		1
Bluegill sunfish	LC_{50} 96h	1.7 mg/L		1
Rainbow trout	LC_{50} 96h	0.16 mg/L		1
Channel catfish	LC_{50} 96h	0.1 mg/L		2
Carp	LC_{50} 72h	0.34 mg/L		1
Carp	LC_{50} 48h	0.67 mg/L		1
Daphnia	*LC_{50} 48h*	*1.14 mg/L*		*1*

[i] TOXICITY (OTHER) — Hydramethylnon is an eye irritant to rabbits. It is not a skin irritant to rabbits or guinea pigs by standard tests.[1] Hydramethylnon dust is non-toxic to honeybees at a topical 0.03 mg/bee.[1] Highly tocxic to fish.[3] Non-teratogenic and non-embryonic in rats and rabbits; non-mutagenic.[1]

[ii] PHYTOTOXICITY – No phytotoxicity observed.[1]

7. METABOLISM

[i] ANIMAL – In rats, following oral administration, rapidly emliminated in the faeces and urine.[1]

[ii] PLANT – Negligible residues were found in radishes, barley, and french beans planted 3 months after treatment of the soil.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. PP
4. USEPA. 1998. R.E.D. Facts: Hydramethylnon. Prevention, Pesticides and Toxic Substances. EPA-738-F-98-022, December.
5. HSDB

Imazamethabenz

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — imazamethabenz (BSI, ANSI, E-ISO)

[ii] TRADE NAME — Assert (Cyanamid Canada Inc.)

[iii] CHEMICAL NAME — methyl-6(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-*m*-toluate and methyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-*p*-toluate

[iv] TYPE / MODE OF ACTION — A selective post-emergence herbicide from the family of imidazolinones. Imidazolinone herbicides inhibit acetolactate synthase which thereby slows production of branched chain amino acids.[2,3]

[v] NOTICE — Product currently **not registered for use in Atlantic Canada**.

2. USE PATTERN

Used on sunflowers and all varieties of barley and wheat for control of wild oats, mustards, and buckwheat.

[i] APPLICATION — May be tank-mixed with most broadleaf herbicides.

[ii] RATE — 0.4-0.7 kg a.i./ha.[1]

CARRIER: Water.

[iii] FORMULATION

1. LI

[iv] SUGGSETED AQUATIC SET BACKS

1. Ground application:	Label: 15 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Do not contaminate water, food, or feed by storage or disposal. Keep container tightly closed. Stable after 24 months at 25°C; hydrolyzes rapidly in alkaline conditions, but slowly at pHs 5 and 7, and it is stable in acidic conditions.[4] Rapdily degraded by UV light in aqueous solution; stable to heat.[4] Shelf life is 2 years. Corrosive to carbon steel and aluminum; solvent may dissolve some plastics and nylon.[4]

4. HANDLING PRECAUTIONS

Wear goggles, face shield and gloves when handling. Imazamethabenz is soluble in most organic solvents. In distilled water, solubility is 1370 mg/kg (m-isomer) and 857 mg/kg (p-isomer). Incompatible with dicamba or amine formulations of 2,4-D or MCPA.[4] Alkaline products may cause imazamethabenz to precipitate.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Half-life of residue in soil is c. 30-105 days.1 Remains in the top 45 cm of soil; no potential for movement with surface water.[4]

[ii] AQUATIC – If released into water, imazamethabenz-methyl is expected to have little to medium adsorption to suspended solids and sediment based upon the K_{oc}. Volatilization from water surfaces is not expected to be an important fate process.[5]

[iii] ATMOSPHERIC – If released to air imazamethabenz-methyl will exist in both the vapor and particulate phase in the ambient atmosphere. Vapor-phase imazamethabenz-methyl will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 24 hours. Particulate-phase imazamethabenz-methyl will be removed from the atmosphere by wet and dry deposition.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg	Males and females	1
Rabbit	LD_{50} dermal	>2000 mg/kg	Males and females	1
Bobwhite quail	LD_{50} oral	>2150 mg/kg		1
Mallard	LC_{50} dietary 8d	>5000 mg/kg diet		1
Rainbow trout	LC_{50} 96h	>100 mg/L		1
Bluegill	LC_{50} 96h	>100 mg/L		1
Bee	LD_{50} contact	>100 ug/bee		1
Daphnia	*EC_{50} 48h*	*>100 mg/L*		*1*

[i] TOXICITY (OTHER) – Non-irritating to skin.[5] Non-mutagenic and non-teratogenic.[4]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Rapidly excreted in animals (rats, goats, hens) after ingestion; low levels of residues found in blood and tissues of rats, in milk and tissues of lactating goats, and in the eggs and tissues of laying hens.[5]

[ii] PLANT - In plants, the methyl group of the benzene moiety is oxidized to a hydroxymethyl group; glucoside conjugates have been identified as secondary metabolites.[5]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. Boldt, L.D. & M.Barrett, "Reducing Imazethapyr Injury to Field Corn (Zea mays) with Napthalic Anhydride", Weed Science, Vol. 39: 640-643, 1991.
3. Shaw, D.R. & M.B. Wixson, " Postemergence Combinations of Imazaquin or Imazethapyr with AC 263,222 for Weed Control in Soybean (Glycine max), Weed Science, Vol. 39: 640-643, 1991.
4. HH
5. HSDB

Imazapyr

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — imazapyr (BSI, ANSI, draft E-ISO, draft F-ISO)

[ii] TRADE NAME — ArsenalArsenalArsenal, *Chopper* (BASF Canada)

[iii] CHEMICAL NAME — 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid

[iv] CAS # — 81334-34-1

[v] TYPE / MODE OF ACTION — A non-selective, broad spectrum, systemic herbicide with residual activity. Imazapyr is from the imidazolinone family. Root and foliar absorption occurs. Inhibits acetohydroxyacid synthetase (AHAS), and acetolactate synthase which in turn slows production of branched chain amino acids.[3,4]

2. USE PATTERN

A herbicide used to control grass and broadleaf weeds in soybean as well as other legumes such as edible beans, alfalfa, peanuts and cereals. Controls woody vegetation in noncrop areas where large equipment can not be used and in sensitive areas where selective control is desired. Can be applied throughout the year by basal bark, cut surface, and injection treatments. An effective pre-emergence and post-emergence herbicide.

[i] APPLICATION — Applicable for industrial weed control, forestry, rubber trees, oil palms and sugarcane. Controls most annual and perennial grasses and broadleaf weeds. Choice of diluent may depend on weather conditions or label instructions.

[ii] RATES — 0.25-1.5 kg/ha

CARRIER: Not identified.

[iii] FORMULATIONS

1. Aqueous liquid with wetting agent.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 15 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Do not mix, store, or apply in unlined steel (except stainless steel) containers or spray tanks. Stable for at least 2 years at 25°C, 1 year at 37°C and 3 months at 45°C.[1] Stable in aqueous media at pH 5 to 9 in the dark; avoid storage >45°C. In solution, the acid is decomposed in simulated sunlight; DT_{50} 6 days at pH 5 to 9.[1]

4. HANDLING PRECAUTIONS

Keep out of reach of children. Avoid contact with skin, eyes, and clothing.

5. ENVIRONMENTAL PERSISTENCE

Data indicates that imazapyr would not dissipate in the environment through volatilization, hydrolysis, or photodegradation (from the soil surface).

[i] SOIL — Imazapyr is slowly decomposed by soil organisms under aerobic but not anaerobic conditions.[1] Residual activity in soil ranges from 6 months-2 years in temperate climates, and 3 to 6 months in tropical climates.[1] The major residue in soil is the parent compound. Bioaccumulation in the environment is highly uunlikely.[1]

[iii] AQUATIC — Photodegradation in aqueous media could be a major route of dissipation in the environment. Imazapyr is stable in aqueous media in the dark at pH5 to pH9. If released into water, imazapyr is not expected to adsorb to suspended solids and sediment based upon the K_{oc}. Exposure to UV light in aqueous solutions caused complete degradation of imazapyr in 48 hours, with a half-life of 7 hours reported. Volatilization from water surfaces is not expected to be an important fate process.[5]

[ii] ATMOSPHERIC – If released to air imazapyr will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase imazapyr will be removed from the atmosphere by wet and dry deposition.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg	Males and females	1
Mouse	LD_{50} oral	>2000 mg/kg	Females	1
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Bobwhite quail	LD_{50} oral	>2150 mg/kg		1
Mallard	LD_{50} oral	>2150 mg/kg		1
Rainbow trout	LC_{50} 96h	>100 mg/L		1
Bluegill	LC_{50} 96h	>100 mg/L		1
Channel catfish	LC_{50} 96h	>100 mg/L		1
Daphnia	*EC_{50} 48h*	*>100 mg/L*		*1*

[i] TOXICITY (OTHER) — This herbicide is non-toxic to Daphnia, algae, bees and soil microorganisms.[2] LD_{50} dermal for honeybees is >100 mg/bee.[1] Eye irritant, mild skin irritant.[5]

[ii] PHYTOTOXICITY – IMAZAPYR-ISOPROPYLAMMONIUM - Non-phytotoxic to conifers. Care should be taken to avoid contact of the spray with the foliage of oil palms and the leaves and young bark of rubber trees.[1]

7. METABOLISM

[i] ANIMAL – In rats, following oral administration, approximately 87 % of the dose was excreted in the urine and faeces within 24 hours.[1]

[ii] PLANT – Following foliar application, residues in plants decline rapidly in the first 24 hours and are exuded from the roots into the soil; the major residue in plants is the parent compound.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. American Cyanamid Co., 1987, data submitted to Agriculture Canada.
3. Boldt, L.D. & M.Barrett, 1991, Reducing Imazethapyr injury to field corn (*Zea mays*) with Napthalic Anhydride, Weed Science, Vol. 39: 640-643.
4. Shaw, D.R. & M.B. Wixson, 1991, Postemergence combinations of Imazaquin or Imazethapyr with AC 263,222 for weed control in soybean (*Glycine max*), Weed Science, Vol. 39: 644-649.
5. HSDB

Imidacloprid

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — imidacloprid (BSI, draft E-ISO)

[ii] TRADE NAME — Admire, Advantage, Merit (Bayer Inc. Ag. Div.)

[iii] CHEMICAL NAME — 1-[(6-chloro-3-pyridinyl)methyl]-*N*-nitro-2-imidazolidinimine

[iv] CAS # — 138261-41-3

[v] TYPE / MODE OF ACTION — Chloronicotinyl insecticide with contact and systemic action.

2. USE PATTERN

Used to control sucking insects such as leafhoppers, aphids, and thrips, and for the control of Colorado potato beetle. Gives residual protection in cereals, potatoes, tomatoes, and sorghum. Registered for use in Ontario, Quebec, and Atlantic Canada.

[i] APPLICATION — Threshold infestation levels should be reached before applying imidacloprid. Can be applied to soil or to foliage. For soil applications, apply as a narrow band in-furrow. For tomato, apply at transplanting as a drench and direct into the root zone.

[ii] RATES — Potato, 0.2-0.31 kg a.i./ha (1.8-2.88 g a.i./100 m row) in soil treatments. For foliar applications use 48.0 g a.i./ha. Tomato, 1.68-2.4 g a.i./100 m row.[2]

CARRIER: Water.

[iii] FORMULATIONS

1. SU
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 15 m
2. Air blast application: Label: 40 m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Avoid cross-contamination with other pesticides. Store in a cool, dry place in original container out of reach of children.[2] Stable to hydrolysis at pH 5-11.[1]

4. HANDLING PRECAUTIONS

Do not use as a foliar treatment following soil use in the same year. Wear long-sleeved shirt and pants, water-proof gloves, and shoes with socks; keep and wash personal protective equipment separately.[5] Wash hands before eating, drinking, using tobacco or the toilet; remove clothing if it becomes contaminated with pesticide, wash thoroughly with detergent and water, change into fresh clothing.[2] Keep out of lakes, streams, ponds and other aquatic systems; do not contaimante water when disposing of equipment washwaters.[2]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Persistent in soil (Half-life ~ 2 years).[3] May leach to groundwater, medium absorption to soil.[1] Stable to hydrolysis under sterile conditions.[1] The microbial activity of a water/sediment system is an important factor for the degradation of imidacloprid.[1]

[ii] AQUATIC — May sorb to sediment. Rapidly degraded by sunlight. Half-life is about 1.4 days in outdoor aquatic dissipation studies.[4]

[iii] ATMOSPHERIC – If released to air imidacloprid will exist in both the vapor and particulate phase in the ambient atmosphere. Vapor-phase imidacloprid will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 4 hours. Particulate-phase imidacloprid will be physically removed from the atmosphere by wet and dry deposition.

[iv] PHYTODEGRADATION – Not identified.[5]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	424 mg/kg	Male; technical grade	4
Rat	LD_{50} oral	450-475 mg/kg	Female; technical grade	4
Rat	LD_{50} oral	>4820 mg/kg	Female; 2.5% granular	4
Rat	NOEL 2y	100 mg/kg diet		1
Rabbit	LD_{50} dermal	>2000 mg/kg	2.5% granular	4
Dog	NOEL 52 weeks	500 mg/kg diet		1
Human	ADI	0.057 mg/kg b.w.		1
Japanese quail	LD_{50} oral	31.0 mg/kg		1
Bobwhite quail	LD_{50} oral	152 mg/kg		4
Mallard	LC_{50}	5000 ppm		4
Rainbow trout	LC_{50} 96h	211 mg/L		1
Shrimp	LC_{50}	0.034 ppm		4
Daphnia	LC_{50}	*85.0 mg/L*		*1*

[i] TOXICITY – Harmful to honeybees by direct contact, but no problems expected when not sprayed into flowering crop or when used as a seed treatment.[1] Non-irritating to eyes and skin (rabbit); not a skin sensitizer.[1] Not mutagenic or teratogenic.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Imidacloprid is quickly largely eliminated from rats, hens and goats.[1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. PMRA
3. Julien, G.R., L.M. Edwards, and P.L. Stewart. 1996. Field and test plot studies of dispersal of imidacloprid (Admire®) in NB and PEI (1995). Environment Canada, Atlantic Region, Dartmouth, NS.EPS-5-AR-98
4. Mullins, J.W. 1993. Imidacloprid. A new nitroguanidine insecticide. *In*: Pest control with enhanced environmental safety. Ed. by S.O. Duke, J.J. Menn, and J.R. Plimmer. ACS Symposium Series (524): 183-193.
5. HSDB

Iprodione

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — iprodione (BSI, E-ISO, F-ISO, ANSI)

[ii] TRADE NAME — Rovral, Foundation (Rhone-Poulene Canada Inc.)

[iii] CHEMICAL NAME — 3-(3,5-dichlorophenyl)-*N*-isopropyl-2,4-dioxoimidazolidine-1-carboxamide

[iv] CAS # — 36734-19-7

[v] TYPE / MODE OF ACTION — An organic compound used as a foliar contact fungicide.

2. USE PATTERN

Particularly effective against *Botrytis, Monilia,* and *Scleratium* spp. It is also effective against other fungi including *Alternaria, Corticium, Fusarium, Helminthosporium, Rhizoctonia, Typhula* spp.[1] It is used mainly on cereals, soft fruit, deciduous tree fruit, ornamentals, vegetables, turf, and vines. Iprodione also inhibits lesion development on peaches and plums.[3]

[i] APPLICATION — May be applied using ground equipment or aircraft. The spray mixture should be agitated thoroughly before and during. Not to be mixed with other pesticides, adjuvants, or fertilizers except where stated on the label. Do not allow to stand in spray tank for over 12 hours. Apply when disease first appears and repeat at 3-week intervals. May also be used as a post-harvest dip.

[ii] RATES — 0.5-11.25 kg a.i. /ha in 100-1000 L water; 15.0-90.0 g a.i./100m^2.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: 0 m
3. Aerial application:	Calculated: 0 m
4. Forestry application:	Not identified.

3. STORAGE

Do not store below 0°C. Do not contaminate water, food, or feed by storage or disposal of this chemical. Relatively stable in acid media, but decomposed in alkaline media. Aqueous solutions are degraded by ultraviolet light, but are relatively stable in simulated sunlight.[1]

4. HANDLING PRECAUTIONS

Do not allow contact with skin or eyes. Use protective clothing, including sleeved shirts or coveralls when handling or spraying iprodione. Do not inhale spray. Do not contaminate domestic or irrigation waters. Do not graze the treated areas.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Half-life in soil ranges from less than 7 days to greater than 60 days; degradation rates vary with soil acidity, soil clay content, and history of the soil fungicide treatment.[4] Slightly soluble and moderately to well sorbed by most soils.[4]

[ii] AQUATIC – Low potential to contaminate groundwater. Compound breaks down rapidly in water under aerobic conditions; rapidly degraded by ultraviolet light.[4]

[iii] ATMOSPHERIC – If released to air iprodione will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase iprodione will be removed from the atmosphere by wet and dry deposition.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>2000 mg/kg		1
Rat	LD_{50} dermal	>2500 mg/kg		1
Rat	NOEL 2y	150 mg/kg diet		1
Mouse	LD_{50} oral	>2000 mg/kg		1
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Dog	NOEL 1y	18.0 mg/kg b.w.		1
Human	ADI	0.3 mg/kg		1
Bobwhite quail	LD50 oral	>2000 mg/kg		1
Mallard	LD_{50} oral	10400 mg/kg		1
Rainbow trout	LC50 96h	4.8 mg/L		1
Bluegill sunfish	LC_{50} 96h	3.7 mg/L		1
Daphnia	*EC_{50} 48h*	*0.25 mg/L*		*1*

[i] TOXICITY (OTHER) — Practically non-toxic to honeybees (LD_{50} contact >0.4 mg/bee); harmless to other beneficial species.[1] Mildly irritating to the eyes. Slightly toxic to wildfowl; moderately toxic to fish species.[4] Not teratogenic at expected exposure levels.[4]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.[2]

7. METABOLISM

[i] ANIMAL – In rats, ruminants and birds, iprodione is rapidly eliminated; undergoes extensive metabolism by hydrolysis and rearrangement reactions.[1]

[ii] PLANT – Iprodione is the dominant component of the total residue resulting from foliar application.[1]

8. ADDITIONAL INFORMATION

Iprodione is considered to be a broad-spectrum fungicide. Control is by contact only.[2]

9. REFERENCES

1. PM
2. AC
3. Fourie, J.F. and G. Holz (1988) Post-harvest fungicidal treatment of stone fruit for the control of *Monilinia laxa, Botrytis cinerea,* and *Rhizopus stolonifer*. Phylophylactica, 19: 73-77.
4. PP
5. HSDB

Lime sulphur

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — lime sulfur (ESA, JMAF); lime sulphur; calcium polysulfide (E-ISO); polysulfide de calcium (F-ISO).

[ii] TRADE NAME — Clean Crop Lime Sulphur (United Agri Products); *Botanix (Les Industries Nobel);* Green Cross Lime Sulphur Liquid (Scotts Canada Ltd.).

[iii] CHEMICAL NAME — calcium polysulfide (II)

[iv] CAS # — 1344-81-6

[v] TYPE / MODE OF ACTION — Direct and protective fungicide and miticide. Also acts as an insecticide by softening the wax of scale insects.[1]

2. USE PATTERN

[i] APPLICATION — Used for control of fungus and mite problems in fruit, alfalfa, beans, clover, and ornamentals. Usually applied in dormant season. Incompatible with many pesticides.

[ii] RATES — Apple, pear, 3.45 mL a.i./L water. Trees and shrubs, 6.9-23.0 mL a.i./L water.[2]

CARRIER: Water, oil or just solution.

[iii] FORMULATIONS

1. EC
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Not identified.
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Not identified.

4. HANDLING PRECAUTIONS

Avoid breathing spray mist. The apple variety "Delicious" may be injured by summer spraying.[2] Wear appropriate chemical protective gloves, boots and goggles.[3] Aviod contact with eyes and skin; burning can be prevented by washing exposed parts with vinegar.[2]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

[i] TOXICITY (OTHER) – Irritating to the skin, eyes and mucous membranes.[2]

[ii] PHYTOTOXICITY – Phytotoxic to sulfur-sensitive plants (apricots, raspberries, cucurbits, etc.).[3]

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. PMRA
3. HSDB

Lindane

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — lindane (BSI, E-ISO, F-ISO, ESA) for grades containing ≥99% gamma-HCH. Also HCH or BHC (E-ISO, F-ISO); HCH (BSI); BHC (JMAF); benzene hexachloride (BPC, ESA, EPA, USA)

[ii] TRADE NAME — Agsco (Agsco Inc.); Benesan, Agrox, Gammasan, *Mergamma* (Chipman Inc.); Gardo (Gardo Products Ltd.); Thiralin Plus, *Rovral* (May and Baker Canada Inc.); Vitoflo, *Vitavax* (Uniroyal Chemical); Premiere (Zeneca Agro); *Busan (Buckman Laboratories of Canada Inc.); Ambrocide (Chapman Chemical Canada Inc.).*

[iii] CHEMICAL NAME — Gamma isomers of 1,2,3,4,5,6-hexachlorocyclohexane

[iv] CAS # — 58-89-9

[v] TYPE / MODE OF ACTION — An organochlorine stomach and contact poison effective as an acaricide against a number of insect pests.

[vi] NOTICE — Registrants voluntarily discontinued registration of products for seed-treatment use on wheat, barley, corn, rye, flax, beans, soybeans and peas. **Sale and usage of these lindane products in Canada will be phased out by December 31, 2004**. Lindane can also be used in shampoo's for headlice in Canada. The US EPA has questioned the re-registration eligibility of lindane products used for seed treatment on six separate crops, but has determined them eligible for re-registration as of July 31, 2002. In the US, lindane is used for seed treatment on barley, corn, oats, rye, sorghum and wheat and is also approved for use in pharmaceutical shampoos and lotions to treat lice and mites in humans.

2. USE PATTERN

As a seed treatment and also on livestock to control certain insect pests. Effective against a wide range of soil-dwelling and phytophagous insects.

[i] APPLICATION — FOLIAGE: Apply uniformly as needed. SEED TREATMENT: Apply by slurry method. Store treated seed below 21°C and use within 3 months. LIVESTOCK: Apply as spray containing not more than 0.06% lindane. SOIL: Apply in band over seed row or broadcast.

[ii] RATES — 0.125-1.0 g a.i./L water or 0.28-4.4 kg a.i./ha.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. DU
3. EC
4. SU
5. SN
6. SR

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 43-58 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable to heat, light, and air. Corrosive to aluminum and metals. Stable in acids, dechlorinated by alkalis. Store in a dry place.

4. HANDLING PRECAUTIONS

Do not use on animals less than 3 months old or animals to be slaughtered within 60 days. Do not use on dairy cattle within 10 days of freshening. Do not use on poultry or poultry houses. Wear protective equipment to avoid personal contact. Contact lenses should not be worn when working with this chemical.[10] Employees should be provided with and required to use dust and splash-proof safety goggles where lindane or liquids containing lindane may contact the eyes.[10] Incompatible with lime, lime sulphur, or calcium arsenate. Should not be used on crops intended for canning. Employees who handle lindane or liquids containing lindane should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.[10] Skin that becomes contaminated with solid or liquids containing lindane should be promptly washed or showered with soap or mild detergent and water to remove any lindane.[10]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Highly persistent in soil, may persist in soil 1 year or more.[3] Applied at 11.2 kg/ha, it lasted for >11 years. Volatilization from moist soil surfaces may be an important fate process. Volatilization half-lives from a sandy soil and a peat soil ranged from 2.3 to 24.8 days. Lindane is expected to be biodegraded in soil under anaerobic conditions, 63.8% biodegraded in three weeks in soil suspensions, while in clay loam soil 60% biodegraded after 15 days. Lindane was not biodegraded in aerobic soil suspensions during a 3 week incubation period.[10]

[ii] AQUATIC – Very stable in both freshwater and saltwater environments; resistant to photodegradation. Dissapates from water by secondary mechanisms including adsorption on sediment and etc.[9] Lindane is expected to adsorb to suspended solids and sediment in the water column based upon sediment K_{oc} values. Volatilization from water surfaces may be an important fate process.[10]

[iii] ATMOSPHERIC – If released to air lindane will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase lindane will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 28 days. Particulate-phase lindane will be removed from the atmosphere by wet and dry deposition. Reported removal rates by rainfall and dry deposition were 2.5 and 3.3%/week, respectively.[10]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD	170 mg/kg		
Rat	LD^{50} dermal	1000 mg/kg		2
Mouse	LD^{50}	86 mg/kg		
Guinea pig	LD^{50}	100-127 mg/kg		
Rabbit	LD^{50}	60-200 mg/kg		
Cow	8-80h	3 x 45 mg/kg	100% mortality	
Hen	LD	70.8 mg/kg		
Hen	50	500 mg/kg	Eggs; 62% mortality	
Mallard	LC	>5000 mg/kg		
Young mallard	LD^{50}	>2000 mg/kg		
Pheasant	LC^{50}	500-600 mg/kg		
Pheasant	1 day after feeding	20 mg ^{14}C lindane	in capsules,	
		1.0 mg/kg	in muscle,	
		52.16 mg/kg	in fat,	
		2.49 mg/kg	in brain, and	
		3.07 mg/kg	in liver	
Pheasant	181 days after feeding	20 mg ^{14}C lindane	in capsules	
			Non-detectable amounts in all 4 organs.	
Bobwhite quail	LC_{50}	120-130 mg/kg		1
Quail	LC_{50}	400-500 mg/kg		
Rainbow trout	LC_{50}	0.002 mg/L		
Rainbow trout	LC_{50} 96h	22ug/L		8
Bluegill	LC_{50} 24h	0.16 mg/L		
Bluegill	LC_{50} 48h	0.088 mg/L		
Bluegill	LC_{50} 96h	0.065 mg/L		
Carp	LC_{50} 96h	0.21 mg/L		4
Sheepshead minnow	LC_{50} 96h	104 µg/L		
Finfish	LC_{50} 96h	30.6 µg/L		
Striped bass	TL_{50}	7.3 mg/L		
Goldfish	LC_{50}	0.131 mg/L		
Hermit crab	LC_{50} 24h	0.038 mg/L		
Grass shrimp	LC_{50} 24h	0.062 mg/L		
Gammarus lacustris	*LC_{50} 24h*	*0.120 mg/L*		
Gammarus lacustris	*LC_{50} 48h*	*0.088 mg/L*		
Toad	LC_{50} 24h	14 mg/L	Tadpoles	
Charus frog	LC_{50} 24h	4.0 mg/L	Tadpoles	
Rutilus rutilus	*Median survival time, 1300 min*	*0.6 mg/L*		
Mysid	LC_{50} 96h	6.3 µg/L		
Stonefly	LC_{50} 48h	0.008 mg/L		
Stonefly	LC_{50} 24h	0.012 mg/L		
Penaeus	LC_{50} 96h	0.17 µg/L		
Water flea	LC_{50} 48h	0.460 mg/L		
Grass shrimp	LC_{50} 96h	4.4 µg/L		

[i] TOXICITY (OTHER) — May be absorbed through skin. C.N.S. stimulant. Toxic to fish and aquatic invertebrates, more so from direct uptake from water than ingestion of contaminated food.[7] Also toxic to wildlife and honeybees. Moderately to practically non-toxic to birds.[9] Lindane causes chromosomal aberrations in leukocyte culture.[6] Unlikely to be teratogenic or mutagenic to humans at normal exposure levels.[9]

[ii] PHYTOTOXICITY — Injury has been reported on potatoes and walnuts. Off flavour has resulted in some crops. Plant damage will occur if used in excessive amounts. Non-phytotoxic when used as recommended, but phytotoxic to cucurbits and hydranges when applied to the foliage.[1]

7. METABOLISM

[i] ANIMAL - Half-life in rat is 3-5 days.[5] Rapid elimination occurs in rats administered orally after metabolism to polar metabolites and to highly water-soluble conjugates.[1]

[ii] PLANT – After uptake by the roots, chlorinated phenols were found.[1]

8. ADDITIONAL INFORMATION

Possesses more vapour activity than most of the organochlorines.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Chin, Y.N. and K.I. Sudderudin (1979) Effect of methamidophos on the growth and esterase activity of the common carp *Cyprinus carpio* L. *Environ. Pollut.* 18: 213-220.
5. Engst, R., R.M. Macholz and M. Kujawa (1977) Recent state of lindane metabolism. *Residue Reviews*, 68: 59-90.
6. Izmerov, N.F., Lindan. IRPTC. Scientific Reviews of Soviet Literature on toxicity and hazards of chemicals. Centre of international projects, GKNT Moscow, 1983
7. Marcelle, C and J.P. Thome (1984) Relative importance of dietary and environmental sources of lindane in fish. *Bull. Environ. Contam. Toxicol.* 33: 423-429.
8. ECOTOX
9. PP
10. HSDB

Linuron

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — linuron (BSI, E-ISO, F-ISO, WSSA, ANSI, JMAF)

[ii] TRADE NAME — Clean Crop Linuron (United Agri Products); Afolan (Agr Evo Canada Inc.); Lorox (DuPont Canada Inc.); Dualin (Ciba-Geigy Canada Ltd.); Amilon; Pfizer's Linuron.

[iii] CHEMICAL NAME — 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea, *or N'*-(3,4-dichlorophenyl)-*N*-methoxy-*N*-methylurea

[iv] CAS # — 330-55-2

[v] TYPE / MODE OF ACTION — Substituted-urea herbicide with systemic activity. Absorbed by roots and foliage and translocated in the xylem. Inhibits photosynthesis.[1]

2. USE PATTERN

Selective weed control in field corn, grain sorghum, soybeans, carrots, celery (post-transplant), parsnips, potatoes, wheat (Pacific Northwest); short-term control of annual weeds in non-crop areas, such as roadsides, fence rows, and shelterbelts (Western Canada). Can control some seedling perennial weeds but will not control established perennials. Both pre- and post-emergence activity. Compatible with atrazine, trifluralin, metribuzin, and others.

[i] APPLICATION — Sprayed on soil as pre-emergence or post-emergence treatment. With suitable surfactant as a directed spray in certain crops, controls weeds up to 13 cm. Without surfactant, as a non-directed post-emergence spray in carrots it controls grasses up to 5 cm high and broadleaf weeds up to 15 cm high.

[ii] RATES — Field corn, 1.08-1.56 kg a.i./ha in 225-335 L water. Potatoes, 1.08-2.2 kg a.i./ha. Fruit trees, 4.32 kg a.i./ha in 400-600 L water.[3] Non-cropland, 1.1-3.3 mg/ha in 182-454 L water. Usual rate for surfactant is 0.5% by volume.

CARRIER: Water in sufficient volume for uniform coverage. Continuous agitation necessary to maintain suspension.

[iii] FORMULATIONS

1. SU
2. WP
3. WG
4. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. Storage

Stable at its M.P. and in solution but slowly decomposed by acids and alkalis. Stable in aqueous solution at pH 5, 7 and 9; DT_{50} 945 days at all three pH values.[1] Non-corrosive and non-flammable. Store in a cool, dry place.[4]

4. HANDLING PRECAUTIONS

Crop injury may result on sandy soils or soils containing less than 1% organic matter, or if application is followed by extremely heavy rain. Do not plant other crops within 4 months of application. Do not apply over the top of corn. Do not graze treated areas. Avoid breathing dust or spray mist. Avoid contact with skin, eyes, and clothing. Wash contaminated clothing with soap & hot water before re-use; keepout of lakes, streams, or ponds.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Moderately persistent in soil. Half-life is 30-150 days under various conditions. Adsorption increases as clay content and/or organic content of soil increases. Leaching is not believed to be an important factor in loss from most soils.[2] Under field conditions when applied at selective rates, phytotoxic concentrations disappear within 4 months. Accumulation from annual application to same soil not a problem.[2] In most soils, degraded to herbicidal inactivity in 3-4 months.[7] Microbial decomposition is the primary factor in loss from soil. Demethylation and demethoxylation processes yield metabolites which are hydrolyzed to 3,4-dichlororoaniline and 4-chloraniline.[7]

[ii] AQUATIC — If released in water, linuron will adsorb to sediment and particulate matter in the soil column and photolyze in surface waters.[4] Because linuron is sufficiently persistent and may be mobile under certain environmental conditions, it has the potential to impact groundwater quality.[8]

[iii] ATMOSPHERIC – If released to air linuron will exist in both the vapor and particulate phase. Vapor-phase linuron will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 12 hours. Linuron absorbs light in the environmental UV spectrum and may undergo direct photolysis. Particulate-phase linuron will be removed from the atmosphere by wet and dry deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1500-4000 mg/kg		1
Rat	LD_{50} dermal	>2000 mg/kg	No effect	7
Rat	90d F.T.	250-1000 mg/kg	Reduced food intake and weight gain	7
Rat	NOEL 2y	125 mg/kg diet		1
Mouse	LD_{50} oral	2400 mg/kg		7
Rabbit	LD_{50} oral	2250 mg/kg		6
Rabbit	LD_{50} dermal	>5000 mg/kg		6
Dog	LD_{50} oral	500 mg/kg		1
Mallard	LC_{50} dietary 8d	3083 ppm		1
Pheasant	LC_{50} dietary	3438 ppm		1
Bobwhite quail	LD_{50} oral	940 mg/kg		1
Bluegill	LC_{50} 96h	16.0 mg/L		5
Rainbow trout	LC_{50} 96h	3.15 mg/L		5
Carp	LC_{50} 24h	20.0-30.0 mg/L		7
Goldfish	LC_{50} 24h	15.0 mg/L		7
Sheepshead minnow	LC_{50} 96h	0.89 mg/L		1
Planaria	*LC_{50} 24h*	*10.0 mg/L*		*7*
Tubifex	*LC_{50} 24h*	*16.0 mg/L*		*7*
Mosquito	LC_{50} 24h	85.0 mg/L	Larvae	7
Chironomus	*LC_{50} 24h*	*>10.0 mg/L*	*Larvae*	*7*
Lebistes reticulata	*LC_{50} 24h*	*8.0 mg/L*		*7*
Mysid shrimp	LC_{50} 96h	3.4 mg/L		1
Daphnia	*LC_{50} 24h*	*4.0 mg/L*		*7*
Daphnia	*EC_{50} 48h*	*0.75 mg/L*		*1*

[i] TOXICITY (OTHER) — May irritate eyes, nose, throat, and skin. Low toxicity to fish and wildlife. LD_{50} for bees 1600μg/g; harmless to other beneficial arthropods.[1] Highly toxic to aquatic invertebrates[8] Non-carcinogenic; non-embryotoxic or teratogenic in rabbit or hen.[7]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

Phenylurea herbicides readily metabolized by most biological systems. Degradation reactions include N-dealkylation, N-dealkoxylation, ring hydroxylation, oxidation of ring substituents, and a small amount of aniline formation.[7]

[i] ANIMAL – Major metabolites arise from demethylation and demethoxylation.[1]

[ii] PLANT – Metabolism involves demethylation and demethoxylation.[1]

8. ADDITIONAL INFORMATION

Often mixed with other herbicides.

9. REFERENCES

1. PM
2. HH
3. PMRA
4. HSDB
5. CESARS
6. PP
7. Maier-Bode, H. and K. Hartel (1981) Linuron and monolinuron. *Residue Reviews* 77: 1-352.
8. USEPA. 1995. R.E.D. Facts: Linuron. Prevention, Pesticides and Toxic Substances. EPA-738-F-95-003, March.

Malathion

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — malathion (BSI, E-ISO, F-ISO, ESA, BAN); maldison (Australia, New Zealand); malathon (JMAF); mercaptothion (Rep. of South Africa); carbofos (USSR); exception (FRG); mercaptotion (Argentina).

[ii] TRADE NAME — MalathionMalathion (United Agri Products, Gardex Chemicals); Later's Malathion (Later Chemicals Ltd.); Sanex (Sanex Agro Inc.); *Cythion (Cyanamid Crop Protection); Riddex (Kemsan Inc.); Melnor (Melnor Canada Ltd.); Guardsmand (Van Waters and Rogers Ltd.).* Other names include Gustafson, Hagen Flea Killer, Pyrocide, Ochemco and Vef-Kem.

[iii] CHEMICAL NAME — diethyl(dimethoxythiophosphorylthio)succinate

[iv] CAS # — 121-75-5

[v] TYPE / MODE OF ACTION — A non-systemic organophosphate insecticide and acaricide (phosphorodithioate group). Inhibits cholinesterase.

[vi] NOTICE — **Malathion is under re-evaluation** in Canada. In November of 2000, the U.S. EPA proposed several risk mitigation measures for malathion products including increased personal protective equipment during agricultural applications, reduced application rates for turf uses, and more specific label storage instructions for domestic uses.

2. USE PATTERN

In addition to a wide range of agricultural and horticultural uses, it is used for the control of mosquitoes, flies, household insects, animal ectoparasites and human head and body lice. Use particularly indicated where a high degree of safety to mammals is desired. Used on fruit, nuts, berries, vegetables, and ornamentals.

[i] APPLICATION — FOLIAGE: Apply at a uniform rate with common application equipment. Repeat as necessary. SOIL: wash into the top 15-20 cm of soil or leave on the soil surface around plants. LIVESTOCK: Dip, spray, or dust individual animals or birds thoroughly. Do not apply within five hours of milking time to dairy animals. SEED AND GRAIN STORAGE: Treat seed with common seed treaters. To grain, apply as it goes into storage. PREMISES: Applied as a spray, or brush on sides of buildings. May also be used as a wet or dry bait. May be applied to ant mounds and to uncultivated land for grasshopper control.

[ii] RATES — Applied at 0.5-2.0 g a.i./L of water or 0.56-3.3 kg a.i./ha; 25-100 mL a.i./100m^2. Backrubbers in dairy and beef cattle, 0.5 L a.i./25 L diesel or fuel oil.[3]

CARRIER: Water, diesel fuel or fuel oil.

[iii] FORMULATIONS

1. PP
2. EC
3. WP
4. SN
5. DU
6. PT

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 2-12 m
2. Air blast application: Calculated: 4(10)-13(22) m
3. Aerial application: Calculated: 20-185 m
4. Forestry application: Not identified.

3. STORAGE

Malathion is rapidly hydrolyzed at pH above 7.0 or below 5.0 but is stable in aqueous solution buffered at pH 5.26. Biological activity of malathion remains practically unvaried for two years under environmental conditions.[4]

4. HANDLING PRECAUTIONS

Corrosive to iron, hence lined containers must be used. Incompatible with alkaline materials. Compatible with most insecticides and fungicides. ULV concentrate may cause spotting on automobile paint.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Low persistence in soil. Field half-lives range from 1-25 days.[5] Biological degradation is rapid.

[ii] AQUATIC — Broken down to mono- and dicarboxylic acids. Half-life is less than one week in raw river water.[5] Hydrolysis may be an important fate process (hydrolysis half-life is 0.2-21 weeks depending on pH). Moderately bound to soils and is soluble in water so it may pose a risk of groundwater or surface water contamination.[5]

[iii] ATMOSPHERIC – If realeased to the atmosphere, malathion will break down rapidly in sunlight, with a reported half-life in air of about 1.5 days.[5]

[iv] PHYTODEGRADATION — Rapidly metabolized by certain aquatic algae.[6]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1375-2800 mg/kg		1
Rat	NOEL 21m F.T.	100 mg/kg diet	Normal weight gain	1
Mouse	LD_{50} oral	775-3320 mg/kg		1
Rabbit	LD_{50} dermal	4100 mg/kg		1
Human	ADI	0.02 mg/kg b.w.		1
Mallard	LD_{50} oral	1485 mg/kg		5
Pheasant	LC_{50} dietary 5d	4320 mg/kg		1
Pheasant	LD_{50} oral	167 mg/kg		5
Bobwhite quail	LC_{50} dietary 5d	3500 mg/kg		1
Chicken	LD_{50} oral	525 mg/kg		5
Rainbow trout	LC_{50} 96h	0.2 mg/L		4
Lake trout	LC_{50} 96h	0.076 mg/L		4
Bluegill sunfish	LC_{50} 96h	0.1 mg/L		1
Coho salmon	LC_{50} 96h	0.17 mg/L		4
Largemouth bass	LC_{50} 96h	0.28 mg/L		1
Walleye	LC_{50} 96h	0.06 mg/L		5
Yellow perch	LC_{50} 96h	0.263 mg/L		4
Fathead minnow	LC_{50} 96h	8.65 mg/L		4
Stonefly	LC_{50} 96h	10.0 µg/L		4
Gammarus fasciatus	*LC_{50} 96h*	*0.76 µg/L*		*4*
Crayfish	LC_{50} 96h	0.18 mg/L		4
Daphnia	*EC_{50} 48h*	*1.0 ug/L*		*4*

[i] TOXICITY (OTHER) — Indirect inhibitor of cholinesterase.[8] Low mammalian toxicity; one of the least toxic organophosphorus compounds. Acute toxicity to mammals considerably less than DDT, but greater tendency to be absorbed through skin.[8] Not stored in tissue to any significant degree.[8] Low toxicity to molluscs but crustaceans are sensitive.[6] Little or no toxicity to birds at practical dosages.[6] Toxic to fish and bees. Highly toxic to aquatic invertebrates and to the aquatic stages of amphibians.[5] No adverses effects on earthworms.[1] Causes molt inhibition in the crab *Oziotelphusa senex senex.*[7] Non-teratogenic, non-carcinogenic (data is not conclusive); does not cause reproductive effects in humans under normal circumstances.[5]

[ii] PHYTOTOXICITY — Injury has been reported on McIntosh and Cortland apples, sweet cherries, certain European grapes, Bosc pears, cucurbits and string beans. Fruit spotting has occurred on nectarines. Some ornamentals have been injured, *e.g.*, ferns, hickory, viburnum, lantana, juniper, petunia, spirea, white pine, maple, and elm.[2] Non-phytotoxic in general, if used as recommended.[1]

7. METABOLISM

[i] ANIMAL – Metabolized by hydrolysis in insects and higher animals. Urinary excretion proportional to dosage; falls to undetectable levels by 3rd day or sooner.[8] Very rapidly eliminated through urine, feaces, and expired air, with a reported haf-life of approximately 8 hours in rats and approximately 2 days in cows.[5] Metabolism occurs by hydrolysis of carboxylate or phosphorodiothioate esters and/or oxidation to the phosphorothioate (maloxon). Malathion is rapidly broken down, mostly by the liver. The breakdown products of malathion appear in the urine within a few hours of exposure. Most metabolites are not harmful, except for maloxon, which attacks an enzyme important for normal nerve function.

[ii] PLANT – Increased moisture content increases degradation.[5]

8. ADDITIONAL INFORMATION

Residues substantially reduced by commercial washing procedures (*e.g.*, 85-95% in tomatoes). Canned tomatoes contain less than 1% of residues present before canning. Washing, blanching, and cooking of broccoli, spinach, kale and other green vegetables reduces residue levels by more than 90%.[8] Tolerance of 135 mg/kg for forage, grass, and green hay allows malathion to be applied on the same days grazed or harvested. Generally established tolerances are for residues of 8.0 mg/kg. Specialized uses with higher and lower tolerances.

9. REFERENCES

1. PM
2. AC
3. PMRA
4. HSDB
5. PP
6. Mulla, M.S. and L.S. Mian (1981) Biological and environmental impacts of the insecticides malathion and parathion on non-target biota in aquatic ecosystems. *Residue Reviews* 78: 101-135.
7. Reddy, P.S., A. Bhagylakshmi and R. Ramamurthi (1985) Molt-inhibition in the crab Oziotelphusa senex senex following exposure to malathion and methyl parathion. *Bull. Environ. Contam. Toxicol.* 35: 92-97.
8. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO meeting on pesticide residues. II Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews* 63: 1-44.

Maleic hydrazide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The trivial names maleic hydrazide (BSI, E-ISO, JMAF) and hydrazide maleique (F-ISO) are accepted in lieu of a common name.

[ii] TRADE NAME — Royal MH, Slo-gro (Uniroyal Chemical Ltd.)

[iii] CHEMICAL NAME — 1,2-dihydro-3,6-pyridazinedione

[iv] CAS # — 123-33-1

[v] TYPE — Plant growth regulator. Absorbed by the leaves and roots, maleic hydrazide inhibits meristematic growth. Also has some herbicidal properties. It is translocated into the plant within 24 hours, especially if cells are turgid.[2]

[vi] NOTICE — **Only the technical active is registered in Canada.**

2. USE PATTERN

To control weeds, in turf and elsewhere, such as wild onion and wild garlic. Used for the temporary inhibition of various trees, shrubs and grasses and controls sprouting of edible onions and potatoes in storage. Used to retard sucker growth of tobacco plants. It also promotes abscission of certain fruits and prevents the development of galls of the root-knot nematode. Can be used on ornamentals.[2]

[i] APPLICATION — Ground spray on actively growing plants and turf. Applied to potatoes within the period between two to three weeks past full bloom and two weeks before expected date of topkill or first frost.[4] Aerial spraying is possible.

[ii] RATES — Potato, 3.39 kg a.i./ha. Onion, 2.25 kg a.i./ha. Grass control, 3.9-4.8 kg a.i./ha in 400 L water.

CARRIER: Aerial applications, minimum of 100 L water. Ground equipment, minimum of 300 L water.

[iii] FORMULATIONS

1. SG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

Formulation has been held at least 10 years with no breakdown. Stable to hydrolysis and heat. Decomposition by strong oxidizing agents with release of nitrogen.[5] Calcium salt precipitated in hard water. Combustible.[5]

4. HANDLING PRECAUTIONS

Do not graze treated areas. Do not use on plants grown for seed production. Do not spray on a hot, dry day when leaves are severely wilted. Not compatible with Bordeaux mixture or highly alkaline pesticides. Do not spray citrus trees within the year in which harvest is to begin. Spray at least 24 hours before a rain. Smoking, eating, drinking, / and using toilet facilities before washing should be absolutely prohibited when any pesticide of moderate or higher toxicity is being handled or used. Remove contaminated clothing and shoes.[5]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Biodegradation may be the major fate process. Rapidly broken down by soil microorganisms.[3] Half-life is approximately 11 hours, but values as high as 100 days have been reported.[4] Expected to be mobile in soils with low clay content. Not likely to contaminate groundwater; could contaminate surface waters if washed in anaerobic soil zones by rainfall after application.[7]

[ii] AQUATIC — Undergoes rapid photochemical degradation. Maleic hydrazide may biodegrade in natural water based upon its observed rapid biodegradation in various soil systems.[5]

[iii] ATMOSPHERIC – If it is released to the atmosphere, maleic hydrazide will exist primarily in the particulate-phase. It may be susceptible to removal from the atmosphere via wet deposition and may be subject to dry deposition.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	3900 mg/kg	Potassium salt	5
Rat	LD$_{50}$ oral	>5000 mg/kg		5
Rat	NOEL F.T.	25.0 mg/kg/d		1
Rabbit	LD$_{50}$ dermal	>20000 mg/kg		1
Mallard	LD$_{50}$ oral	>2250 mg/kg	Potassium salt	1
Mallard	LD$_{50}$ oral	>4640 mg/kg		1
Bobwhite quail	LC$_{50}$ dietary 8d	>10000 ppm		1
Rainbow trout	LC$_{50}$ 96h	1435 mg/L		1
Bluegill sunfish	LC$_{50}$ 96h	1608 mg/L		5
Harlequin fish	LC$_{50}$ 24h	530 mg/L		6
Harlequin fish	LC$_{50}$ 96h	125 mg/L		6
Daphnia	*LC$_{50}$ 96h*	*107 mg/L*		*5*
Daphnia	*EC$_{50}$ 48h*	*>1000 mg/L*	*Potassium salt*	*1*

[i] TOXICITY (OTHER) — Both maleic hydrazide and its sodium salt have a low order of toxicity. Non-irritant. Non-toxic to birds, fish, invertebrates and honeybees.[7] Non-carcinogenic and non-teratogenic.

[ii] PHYTOTOXICITY — For tobacco suckering, spraying too early may prevent normal development of the top leaves, while spraying too late will allow some sucker growth.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Becomes fixed within plants; not metabolized.[3]

8. ADDITIONAL INFORMATION

Mildly fungicidal. May improve grade by reducing roughness of potatoes, especially Russet Burbanks, if application is made prior to any secondary tuber formation.[4]

9. REFERENCES

1. PM
2. AC
3. HH
4. PMRA
5. HSDB
6. CESARS
7. USEPA. 1994. R.E.D. Facts: Maleic hydrazide. Prevention, Pesticides and Toxic Substances. EPA-738-F-94-009, June.

Mancozeb

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — mancozeb (BSI, E-ISO), mancozebe (F-ISO), manzeb (JMAF).

[ii] TRADE NAME — Dikar, Dithane (Rohm and Haas Canada Inc.); Manzate (Dupont Canada Inc.); Ridomil MZ (Novartis Crop Protection); Acrobat (BASF Canada); Tuberseal (Norac Concepts Inc.).

[iii] CHEMICAL NAME — manganese ethylenebis (dithiocarbamate) (polymeric) complex with zinc salt.

[iv] CAS # — 8018-01-7

[v] TYPE / MODE OF ACTION — Fungicide with protective action.

2. USE PATTERN

Controls fungal diseases including downy mildew, leaf spot, and scab in field, vegetable, and fruit crops, and ornamentals. Effective against early and late blight in potato and tomato. Compatible with most pesticides including zineb, metalaxyl, dinocap, maneb, and others.

[i] APPLICATION — Applied to foliage or used as a seed treatment. Ensure thorough coverage and penetration.

[ii] RATES — Potatoes, 0.67-1.41 L a.i./ha. Vegetable crops, 0.67-2.04 L a.i./ha. Fruit crops, 0.93-1.22 L a.i./ha. Seed treatment, 80.0 g a.i./100 kg of seed. Wheat, 0.83-1.69 kg a.i./ha.

CARRIER: Not identified.

[iii] FORMULATIONS

1. WP
2. DU
3. SN

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Label: 50 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Label: 100 m
4.	Forestry application:	Not identified.

3. STORAGE

Biological activity remains practically unvaried for two years if stored in shaded, well-aired areas.[2] Stable under normal, dry storage conditions. Slowly decomposed by heat and moisture.[1]

4. HANDLING PRECAUTIONS

Wear a long sleeve shirt and long pants or a coverall that covers all parts of the body except the head, hands, and feet; chemical resistant gloves; shoes, socks, and goggles or a face shield. During mixing and loading, a chemical resistant apron must also be worn.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Low persistence in soil (Half-life ~6-15 days).[1] Rapidly degrades to ethylenethiourea (ETU) in the presence of water and oxygen.[5] Also rapidly degraded by hydrolysis, oxidation, photolysis, and metabolism.[1]

[ii] AQUATIC — Half-life is 1-2 days under slightly acidic to slightly alkaline conditions.[5] Hydrolysis may be an important fate process. If released into water, mancozeb is expected to adsorb to sediment and suspended solids in water based upon the K_{oc}. Volatilization from water surfaces is not expected to be an important fate process.[4]

[iii] ATMOSPHERIC – If released to air mancozeb will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase mancozeb will be removed from the atmosphere by wet and dry deposition. Mancozeb has a photolysis rate constant of > 5.5/day in air which equates to a half-life of < 3 hrs.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg		1
Rabbit	LD_{50} dermal	>5000 mg/kg		5
Mallard	LC_{50} dietary 10d	6400 ppm		5
Rainbow trout	LC_{50} 48h	2.2 mg/L		1
Rainbow trout	LC_{50} 96h	1.1 ppm		6
Catfish	LC_{50} 48h	5.2 mg/L		1
Carp	LC_{50} 48h	4.0 mg/L		4
Goldfish	LC_{50} 48h	9.0 mg/L		1

[i] TOXICITY (OTHER) — Not toxic to bees (LC_{50} 0.193 mg/bee). ETU, a breakdown product of mancozeb, has caused thyroid effects, tumours, and birth defects in laboratory animals.[1] Slightly toxic to birds; moderately to highly toxic to fish and aquatic organisms.[5] Non-mutagenic. Teratogenicity and carcinogenacity of mancozeb is unknown.[5]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL - In animals, mancozeb is rapidly absorbed from the gastrointestinal tract and almost completely excreted within 96 hours.[5]

[ii] PLANT – Extensively metabolized in plants.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. PMRA
4. HSDB
5. PP
6. ECOTOX

Maneb

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — maneb (BSI, E-ISO, JMAF); manebe (F-ISO)

[ii] TRADE NAME — Agsco (Agsco Inc.); Agrox N-M, *Mergamma* (Zeneca Agro); Manzate D, Tersan (DuPont Canada Inc.); Ipco NM (Interprovincial Co-op Ltd.); Marzone (Marzone Chemicals Ltd.); Maneb (BASF Canada); Dithane M-45 (Rohm & Haas Canada Inc.); *Wilson's Maneb (Wilson Laboratories Ltd.).*

[iii] CHEMICAL NAME — manganese ethylenebis (dithiocarbamate)

[iv] CAS # — 12427-38-2

[v] TYPE / MODE OF ACTION — A broad spectrum carbamate foliar protectant fungicide similar to mancozeb.

2. USE PATTERN

For the control of potato and tomato early and late blights, leaf spots, anthracnose of cucumber, spinach blue mold, shot hole, cranberry fruit rot, peach leaf curl, grape black rot, alternaria leaf spot, downy mildew, celery blights, onion purple blotch, rusts, brown rot, rose black spot, and many others. Used on numerous fruits and vegetables, almonds, flax, oats, roses, tobacco, turf, wheat, and ornamentals.

[i] APPLICATION — Apply evenly to foliage at a uniform rate when disease threatens. Repeat as necessary, usually at 7-10 day intervals. Applications should be more frequent when weather conditions favour disease development. Use of a spreader sticker may be necessary. Also used as a seed treatment prior to planting.

[ii] RATES — Vegetable crops, 1.8-2.6 kg a.i./ha. As a seed treatment in cereals, 19.5-34.5 g a.i./25 kg of seed.

CARRIER: Dry, solution.

[iii] FORMULATIONS

1. WG
2. DU
3. WP
4. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store below 40°C. [2] Never allow this material to become wet during storage as flammable vapours may be created.[4] Stable to light; decomposes on prolonged exposure to air or moisture.[1] It decomposes at about 100° C and may spontaneously decompose vigorously when stored in bulk.[5] This product must be stored in its sealed original containers, in well-aired places; the containers must be stacked in such a way as to permit a free circulation of air also at the bottom and inside of the piles.[5]

4. HANDLING PRECAUTIONS

May be absorbed through the skin and throat, avoid bodily contact. Avoid breathing vapors; keep upwind. Do not handle broken packages unless wearing appropriate personal protective equipment. [5]

5. ENVIRONMENTAL PERSISTENCE

Only small quantities find their way into the soil, and once there are rapidly degraded. Maneb is destroyed within 2-3 weeks in the environment but its decomposition products preserve for over a month.[7]

[i] SOIL — Half-life in a sandy loam soil is ~25 days under aerobic conditions.[1] Maneb is strongly bound by moist soil and is expected to be of low mobility. Can persist in soil for >75 days. Rapidly degraded to ethylene thiourea, ethylene thiuram monosulphide, CS_2 and H_2S. Ethylene thiourea is further degraded to ethylene urea. Unstable in soil, but cases of direct dithiocarbamate decomposition under the influence of microorganisms, have not been encountered up to the present.[7]

[ii] AQUATIC — The half-life in water at 20°C is 20 days.[4] Abiotic processes including hydrolysis and photodegradation are important fate processes.[5]

[iii] ATMOSPHERIC - If released to air maneb will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase maneb will be removed from the atmosphere by wet and dry deposition. Aqueous solutions of maneb absorb UV light in the spectrum between 290 and 360 nm and this indicates a potential for direct photolysis in the environment.[5]

[iv] PHYTODEGRADATION — Half-life on leaves is 14 days.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000-8000 mg/kg		6
Rat	NOEL 2y F.T.	250 mg/kg diet	No ill-effect	1
Rabbit	LD_{50} dermal	>5000 mg/kg		1
Dog	NOEL 1y	20.0 mg/kg diet		1
Bobwhite quail	LC_{50} dietary 8d	>10,000 ppm		6
Rainbow trout	LC_{50} 48h	1.9 mg/L		6
Bluegill sunfish	LC_{50} 96h	1.0 mg/L		6
Carp	LC_{50} 48h	1.8 mg/L		1
Crayfish	LC_{50} 72h	>40.0 mg/L		6

[i] TOXICITY (OTHER) — Degradation product, ethylene thiourea is carcinogenic. No evidence of teratogenic effects in rats or mice at levels below maternal toxicity. Not toxic to birds.[5] Highly toxic to fish. Not toxic to bees.[1] Non-mutagenic, non-teratogenic in humans under normal circumstances, unlikely to be carcinognenic in humans.[6]

[ii] PHYTOTOXICITY — Generally non-phytotoxic except to zinc-sensitive varieties. May cause damage to some varieties of apple and cucurbits.[1]

7. METABOLISM

[i] ANIMAL - In animals, readily absorbed from the gastrointestinal tract and eliminated rapidly. In rats, 55% of an administered dose was eliminated within 5 days.[6]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Compatible with common insecticides and fungicides. It may be applied up to the day of harvest to some crops. Controls a wider range of diseases than any other single fungicide.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. PP
7. Izmerov, N.F. (1983) Maneb. Scientific Reviews of Soviet Literature on Toxicity and Hazards of Chemicals, 48. Centre of International Projects, GKNT, Moscow.

MCPA

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — MCPA (BSI, E-ISO, F-ISO, WSSA); 2,4-MCPA (France); 2M-4Kh, formerly metaxon (USSR); MCP (JMAF)

[ii] TRADE NAME — Blagal (Dupont Canada Inc.), MCPA-K (Nufarm); Marks MCPA (A.H. Marks and Company Ltd.); Buctril M (Rhone-Poulenc Canada Inc.); Estemine (United Agri Products); Mirage (BASF Canada Inc.); Ipco MCPA, Tropotox (Interprovincial Co-op Ltd.); Buctril, Bromox (Aventis CropScience Canada).

[iii] CHEMICAL NAME — 4-chloro-*o*-tolyloxyacetic acid

[iv] CAS # — 94-74-6

[v] TYPE / MODE OF ACTION — Systemic hormone-type herbicide; similar to 2,4-D except for replacement of one chlorine atom by a methyl group. Interferes with protein synthesis and cell division in meristematic tissue.[1]

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Selective foliage broadleaf killer. More selective than 2,4-D at equal rates on cereals, legumes, and flax. Controls mustards, plantain, arrowhead lily, sedges, bindweed, burhead, lambsquarters, puncurevine, ragweed, cocklebur, purslane, peppergrass, and many others. Also used on pastures and rangeland.

[i] APPLICATION — Aerial and ground application: low-volume spray. Use on young rapidly growing weeds. Use higher rates on perennials. FLAX: Apply when flax is 5-20 cm tall but before budding. Do not spray between full bloom and the stage when 90% of the bolls have formed.[2] GRAIN: Apply when grain is fully tillered and 20-25 cm tall. Do not spray in the boot or dough stage. Especially recommended for use on oats since they are more susceptible to 2,4-D than the other small grains.[2] RICE: Apply 55-65 days after planting when rice is fully tillered and 15-20 cm above water. Do not spray when rice is in boot stage.[2] Established LEGUMES: Apply in spring while they are still dormant for control of winter annual weeds. Also applied immediately after cutting.[2] TURF: Apply in the spring or fall but do not mow two days before or after treatment.[2]

[ii] RATES — 0.13-2.2 kg a.i./ha in 23-455 L of water.

CARRIER: Water.

[iii] FORMULATIONS

1. SU
2. SN
3. SO
4. EC
5. DU
6. K, Na and dimethylamine salts; butyl, isoctyl and butoxyethyl esters.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

Amine salts are stable indefinitely. Ester shelf life varies with formulation. Non-volatile. Do not transport or store near fertilizers, seeds, insecticides or fungicides.

4. HANDLING PRECAUTIONS

Avoid spray drifts onto susceptible plants such as grapes, tomatoes, and cotton. Do not contaminate water for irrigation or domestic use.

5. ENVIRONMENTAL PERSISTENCE

Average persistence at recommended rates is up to 9 months in moist conditions and up to 6 months under drier climates.

[i] SOIL — MCPA applied at a rate of 0.56-1.36 kg/ha persisted for 1-4 weeks in a moist loam soil. MCPA applied at 25.0 mg/kg in soil persisted for >103 days. Half-life in Saskatchewan soils 2-6 weeks.[7] Readily leached from soil. Duration of residual activity is ~3-4 months following an application of 3.0 kg/ha.[1] Rapidly degraded by soil microorganisms. Probable hydroxylation of compound and cleavage of ether linkage.

[ii] AQUATIC – In either the atmosphere or environmental waters, 4-chloro-2-methylphenol may undergo photolysis due to the absorption of UV light wavelengths > 290 nm. Because 4-chloro-2-methylphenol has a pKa of 9.71 at 25° C it will exist in both the undissociated and the anionic form under alkaline conditions. Based upon an estimated K_{oc} of 775, 4-chloro-2-methylphenol is expected to maintain a low mobility and partition to sediments and particulate materials in the water column among acidic and neutral soils and waters, respectively.[4]

[iii] ATMOSPHERIC – If released to the atmosphere, 4-chloro-2-methylphenol may be physically removed by settling or washout in precipitation. 4-Chloro-2-methylphenol is degraded rapidly in air by reaction with photochemically produced hydroxyl radicals at an estimated half-life rate of 1.25 days.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	900-1160 mg/kg		1
Rat	NOEL 2y	c. 1.33 mg/kg/d		1
Mouse	LD_{50} oral	550-800 mg/kg		6
Rabbit	LD_{50} dermal	>4000 mg/kg		6
Bobwhite quail	LD_{50} oral	377 mg/kg		1
Rainbow trout	LC_{50} 96h	232 mg/L		4
Bluegill sunfish	LC_{50} 96h	>10.0 mg/L	Static bioassay	4
Bluegill sunfish	LC_{50} 48h	1.5 mg/L		4
Goldfish	LC_{50} 48h	>40.0 mg/L		5
Fathead minnow	LC_{50} 96h	145.3 mg/L	QSAR estimate5	

[i] TOXICITY (OTHER) — Not toxic to bees (LD_{50} 0.104 mg/bee). Safe for fish at 10.0 mg/L. Non-mutagenic, unlikely that teratogenic effects will occur in humans at expected exposure levels.[6]

[ii] PHYTOTOXICITY — Very sensitive crops include grapes, vegetables, fruit trees, ornamentals, and cotton. In certain areas, injury has resulted on bent, buffalo, carpet, and 51 augustine grasses.[2]

7. METABOLISM

[i] ANIMAL – Following oral administration in rats, only moderate metabolism occurs. Much of the dose is excreted in the urine.

[ii] PLANTS - In plants, inactivation follows many pathways. Complexing by proteins is probable. Decarboxylation occurs in many instances.[3] Actively broken down in plants, the major metabolite being 2-methyl-4-chlorophenol.[6]

8. ADDITIONAL INFORMATION

This is one of the first hormone sprays used in England.[2]

9. REFERENCES

1. PM
2. AC
3. HH
4. HSDB
5. CESARS
6. PP
7. Norris, L.A. (1981) The movement, persistence and fate of the phenoxy herbicides and TCDD in the forest. *Residue Reviews* 80: 66-135.

MCPB

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — MCPB (BSI, E-ISO, F-ISO, WSSA, JMAF); 2,4-MCPB (France); 2M-4Kh-M (USSR).

[ii] TRADE NAME — Tropotox (Nufarm Agriculture); Clovitox (Interprovincial Cooperative Limited).

[iii] CHEMICAL NAME — 4-(4-chloro-*o*-tolyloxy)butyric acid

[iv] CAS # - 94-81-5

[v] TYPE / MODE OF ACTION — A phenoxy compound used as a selective, translocated herbicide applied post-emergence.

2. USE PATTERN

For control of Canada Thistle and other broadleaf weeds (such as lambsquarters, pigweed, smartweed, sow thistle, and annual morning glory) in peas.

[i] APPLICATION — Apply uniformly and thoroughly but not to the point of runoff. Apply when weeds are growing vigorously but before they become established. A second treatment may be made for the control of certain hard-to-kill weeds. Avoid cutting or mowing 2-3 days before and after treatment. Weeds should be less than 7.6 cm tall.

[ii] RATES — Apply at 1.4-1.7 kg a.i./ha in 150-200 L water 276 kpa maximum pressure.

CARRIER: Not identified.

[iii] FORMULATIONS

1. SN
2. Available as the amine and potassium salts.
3. Formulated with a number of post-emergence herbicides.

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 0 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

No limitations. Non-flammable. Possible incompatibility with hard water.

4. HANDLING PRECAUTIONS

Do not apply when turf is suffering for water. Do not apply in unusually wet or hot weather. Avoid drift. Do not apply when temperatures exceed 32°C. Do not use the first cutting after treatment as a mulch for flowers and vegetables. Handle carefully. Do not contaminate water, food, or feed by storage or disposalof this chemical.[7] Cleaning glassware and spray equipment; thoroughly flush with detergents, dilute alkali, and water.[7]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – If released to soil, adsorption may be important (estimated K_{oc} of 520). However, a pKa value of 6.2 at 25° C indicates that MCPB will be 99% dissociated at pHs 8.2 and higher. The half-life in soil typically ranges from less than 7 days to 14 days. Removal via beta-oxidation to 2-methyl-4-chlorophenoxyacetic acid appears to be the primary removal process in soil and water. Furthermore, biodegradation will be important under anaerobic conditions.[7]

[ii] AQUATIC – If released to water, volatilization and bioconcentration in fish will not be important. Based on structural analogy, photodegradation may occur in near surface water.[7]

[iii] ATMOSPHERIC – If released to the atmosphere, MCPB will exist in the vapor and particulate-phases; vapor phase MCPB degrades by reaction with photochemically produced hydroxyl radicals (estimated half-life of 18 hours). Physical removal from air may occur through dry deposition.[7]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	4700 mg/kg	MCPB	1
Rat	LD_{50} oral	1780 mg/kg	Males; MCPB-ethyl	1
Rat	LC_{50} inhalation 4h	1.14 mg/L air		1
Mouse	LD_{50} oral	800 mg/kg		4
Bobwhite quail	LD_{50} oral	282 mg/kg	MCPB-sodium	1
Rainbow trout	LC_{50} 96h	4.3 ppm		6
Fathead minnow	LC_{50} 48h	11.0 mg/L		1
Rainbow trout	LC_{50} 48h	75.0 mg/L	No adverse effects	2

[i] TOXICITY (OTHER) — Toxic to earthworms at 6.0 L/ha (25% a.i.).[5] Causes pain and irritation on eyes and mucous membranes.[7] Toxic by ingestion.[7]

[ii] PHYTOTOXICITY — Injury in the form of twisting may occur with some pea varieties.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Susceptible weeds convert this compound into MCPA and are killed, whereas most legumes are unable to make this conversion and are tolerant.[3]

8. ADDITIONAL INFORMATION

Safer than other phenoxy compounds on fine turf grades (bentgrass, bluegrass, etc). May be mixed with 2,4-D to get a larger range of weeds, but do not use the mixture on bentgrass turf. Relatively slow in its action requiring 3-4 weeks for control. Effective only on broadleaves. May be applied close to woody shrubs bordering turf without injury if foliage is not contacted. Non-corrosive. Weeds such as black medic, dock, English daisy, knotweed, mallow, purslane, and oxalis should be treated early for best results.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. Maier-Bode, H. and K. Hartel (1981) Linuron and monolinuron. *Residue Reviews*, 77: 1-352.
6. ECOTOX
7. HSDB

Mecoprop

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — mecoprop (BSI, E-ISO, F-ISO, WSSA); mechlorprop (Denmark); MCPP (JMAF)

[ii] TRADE NAME — Co-op Premium 3-way (Interprovincial Co-op Ltd.); Par III (United Agri Products); Target (Novartis Crop Protection Canada Ltd.); Compitox, Mecoturf (Nufarm UK Ltd.)

[iii] CHEMICAL NAME — (*RS*)-2-(4-chloro-*o*-tolyloxy)propionic acid

[iv] CAS # — 1929-86-8

[v] TYPE / MODE OF ACTION — A phenoxyacetic acid used as a translocated selective herbicide.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Particularly effective for control of chickweed, cleavers, clover, and plantain. It is useful for control of weeds in cereals such as wheat, oats and barley and for lawn and turf.

[i] APPLICATION — Post-emergence foliar application.

[ii] RATES — Bent grass, 3.0 g a.i./100 m^2 in 20 L water. Turf, 0.55 kg a.i./ha in 300 L water.[3]

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. SN
3. Available as the amine and potassium salts.
4. Formulated with a number of post-emergence herbicides.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

Solution of the potassium salt of mecoprop is stable for several years under normal storage conditions. At low temperatures the potassium salt will crystalize out of solution, but the crystals will redissolve on warming. Non-flammable. Acid corrosive to metal; potassium salt does not corrode brass, iron, and mild steel at pH >8.6. Stable to heat and to hydrolysis, reduction and atmospheric oxidation.[1] Do not store near heat or flame; protect from freezing.[4]

4. HANDLING PRECAUTIONS

Do not apply in unusually wet or hot weather. Avoid drift. Do not apply when temperatures exceed 32°C. Wear protective suits (preferably disposable, one-piece and close-fitting at ankles and wrists), gloves, hair covering and overshoes. Carefully fitted masks or respirators may be necessary when working with particulates or gases, disposable plastic aprons might provide additional protection.[4]

5. ENVIRONMENTAL PERSISTENCE

3-4 weeks after treatment with recommended rates is satisfactory for planting.

[i] SOIL — Biodegrades and leaches rapidly. Half-life in soil ranges from 3-21 days.[4] Duration of residual activity in soil is approximately 2 months. Mecoprop will be lost in runoff.[4]

[ii] AQUATIC —Mecroprop is a weak acid and will exist in the anionic form in water. If released into water, it is not expected to adsorb to sediment or particulate matter in the water column, or be lost through volatilization. It biodegrades in soil and groundwater and would therefore would be expected to biodegrade in surface water.[4]

[iii] ATMOSPHERIC – Mecoprop will be released to the atmosphere as an aerosol during spraying applications and will be removed from the air by gravitational settling. Although mecoprop should occur as an aerosol in the atmosphere because of its very low vapor pressure, any mecoprop in the vapor phase would react with photochemically-produced hydroxyl radicals, resulting in a half-life of 22 hr.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	930-1166 mg/kg		1
Rat	NOEL 2y	1.1 mg/kg/d		1
Rat	210d	100 mg/kg diet	Slight enlargement of kidney	1
Mouse	LD_{50} oral	650 mg/kg		2
Rabbit	LD_{50} dermal	900 mg/kg	Mecoprop sodium	4
Japanese quail	LD_{50} oral	740 mg/kg		1
Trout	LC_{50} 96h	150-220 mg/L		1
Bluegill sunfish	LC_{50} 96h	>100 mg/L		1
Daphnia	*EC_{50} 48h*	*420 mg/L*		*1*

[i] TOXICITY (OTHER) — Toxicity is similar to that of other phenoxy herbicides. Not toxic to bees (LD_{50} oral >10.0 ug/bee).[1] Moderate bioconcentration potential. Irritant to skin and eyes; may be fatal if inhaled, ingested or absorbed through skin.[4]

[ii] PHYTOTOXICITY – Not identified.

7. ADDITIONAL INFORMATION

[i] ANIMAL – Following oral administration in mammals, mecroprop is predominantly eliminated unchanged in the urine as conjugates.[1]

[ii] PLANT - May be mixed with 2,4-D to control a larger range of weeds. Relatively slow in its action requiring 3-4 weeks to control. Effective only on broadleaves.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. HH
3. PMRA
4. HSDB

Metalaxyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — metalaxyl (BSI, E-ISO, F-ISO, ANSI)

[ii] TRADE NAME — Ridomil, Subdue (Novartis Crop Protection Canada Ltd.); *Apron (Ciba Geigy Ltd.).*

[iii] CHEMICAL NAME — methyl *N*-(2-methoxyacetyl)-*N*-(2,6-xylyl)-DL-alaninate

[iv] CAS # — 57837-19-1

[v] TYPE / MODE OF ACTION — Fungicide (protective with systemic properties) and herbicide; acylalamine compound. Inhibits protein synthesis in fungi.

2. USE PATTERN

Used on apples, vegetables, grain crops, hops, melons, peanuts, pineapple, tobacco, turf, etc. Control of air and soil-borne Oomycetes. Recommended for use on potatoes against *Phytophthora infestans*, in grape vines against *Plasmopara viticola*, in tobacco against *Perenospora tabacina*, in hops against *Pseudoperonospora humili* using metalaxyl and folpet or Cu fungicides, and in lettuces against *Pythium spp.* at 2.3 g a.i./100 m row.

[i] APPLICATION — Used as a seedbed treatment, a soil applied fungicide, and a foliar spray in the U.S. Apply and repeat as necessary. May be applied through the irrigation system. Do not use on greenhouse crops. Do not apply to tobacco as a foliar application.

[ii] RATES — Potato, 200 g a.i./ha. Strawberry, 1.0 kg a.i./ha for new and established plantings. Tobacco, 1.13 kg a.i./ha. Apple (non-bearing), 1.02 g a.i./tree in 5 L water.[3]

CARRIER : Water.

[iii] FORMULATIONS

1. EC
2. WP
3. GR
4. DU
5. SN
6. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

Corrosive. Lasts at least 3-5 years when stored in a dry place and minimum storage temperatures (above 0°C) are observed.[2] Stable up to 300°C; in neutral and acaidc media at room temperature.[1]

5. HANDLING PRECAUTIONS

Do not get in eyes, on skin or on clothing. Wear goggles or face shield and rubber gloves when handling. Change clothing after use; wash with soap and water after use. Avoid application when weather conditions favor drift from treated areas. Do not eat, smoke or drink while mixing or during application. Do not contaminate streams, lakes, ponds, irrigation water, water used for livestock or domestic purposes by cleaning of equipment or disposal of wastes.[6]

6. ENVIRONMENTAL PERSISTENCE

Effective against *Phytophora cinnamomi* for up to 18 months after treatment.[5]

[i] SOIL — Metalaxyl exhibits long-lasting activity. Soil activity lasts 70-90 days. Half-life of 7-170 days under field conditions.[4] Leaches readily in sandy soil. Because it is poorly sorbed to soils, highly soluble in water and persistent in soils, contamination to groundwater may occur.[1]

[ii] AQUATIC — Half-life in water (pH 5-9 and 20-30°C) is >4 weeks.[4] If released into water, metalaxyl is not expected to adsorb to suspended solids and sediment based upon the range K_{oc} values. Volatilization from water surfaces is not expected to be an important fate process.[6]

[iii] ATMOSPHERIC – If released to air metalaxyl will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase metalaxyl will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 14 hrs. Particulate-phase metalaxyl will be removed from the atmosphere by wet and dry deposition.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	669 mg/kg		4
Rat	NOEL	2.5 mg/kg/d		1
Rabbit	LD_{50} oral	697 mg/kg		1
Rabbit	LD_{50} dermal	>3100 mg/kg		2
Dog	NOEL	8.0 mg/kg/d		1
Bobwhite quail	LC_{50} dietary 8d	>10000 ppm		1
Rainbow trout	LC_{50} 96h	>100 mg/L		4
Carp	LC_{50} 96h	>100 mg/L		4
Bluegill	LC_{50} 96h	>100 mg/L		4
Daphnia	*LC_{50}*	*12.5-28.0 mg/L*		*4*

[i] TOXICITY (OTHER) — Negligible toxicity to wildlife. May cause some skin irritation. In laboratory trials it is practically non-toxic to honeybees and birds. Non-toxic to fish.[1] Causes slight irritation to eyes of rabbits, not to skin.[1] Unlikely to cause reproductive effects, non-teratogenic, non-mutagenic.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In mammals, following oral administration, metalaxyl is rapidly absorbed and also rapidly and almost completely eliminated with urine and faeces.[1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Repeated exclusive use may lead to the development of resistant strains of fungi.

9. REFERENCES

1. PM
2. FCH
3. PMRA
4. PP
5. Bensen, D.M. (1987) Residual activity of metalaxyl on population dynamics of *Phytophora cinnamomi* in landscape beds of azalea. *Plant Disease* 71: 889-890.
6. HSDB

Metaldehyde

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The name metaldehyde (BSI, E-ISO, F-ISO, JMAF) is accepted in lieu of a common name.

[ii] TRADE NAME — Deadline (Pace National Corp. (USA)); Ct-6 (Chipman Inc.); Later's Metaldehyde (Later Chemicals Ltd.)

[iii] CHEMICAL NAME — *r*-2,*c*-4,*c*-6,*c*-8-tetramethyl-1,3,5,7-tetroxocane is the main compound.

[iv] CAS # — 108-62-3

[v] TYPE / MODE OF ACTION — A metacetaldehyde compound used as a molluscicide, attractant and toxicant for slugs and snails.

2. USE PATTERN

Used as a bait on soil surfaces around vegetable crops in field or greenhouse; on the soil around trees in avocado or citrus orchards, around blackberry, blueberry, dewberry, boysenberry, loganberry, strawberry, raspberry, and banana plants. Also used on ornamental plants.[3] For control of slugs and snails. Very slight insecticidal action. Also used in certain areas to control frogs, leeches, and fish.[3]

[i] APPLICATION — As a bait to the soil. As powder or dust to the foliage. Apply in late afternoon or at night. Good sanitation will add to effectiveness of treatment.[3] Do not bring into direct contact with foliage.[3] Do not apply just before rain.

[ii] RATES — 2440 g/ 100 m^2 or 2.24 kg/ha.

CARRIER: Not identified.

[iii] FORMULATIONS

1. PT
2. GR
3. SN
4. SO
5. PE
6. PA
7. IF

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Store in a cool place to minimize sublimation. Subject to depolymerization, hence a need for care in storage, for which soldered tinplate is unsuitable. This material is combustible. Depolymerization occurs slowly on heating, and rapidly above 80°C.[7]

4. HANDLING PRECAUTIONS

Store in a cool place. Avoid prolonged storage. Do not use baits in an area where they may be eaten by animals or children. Avoid bodily contact with the material. Do not handle broken packages unless wearing appropriate personal protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap and water.[7]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Aerobic and anaerobic microorganisms in soil decompose metaldehyde to CO_2 and water.[1] Is of low persistence in the soil environment, with a half-life of several days; weakly sorbed by soil organic matter and clay particles, and is soluble in water.[6]

[ii] AQUATIC – Undergoes rapid hydrolysis to acetaldehyde, and should be of low persistence in the aquatic environment.[6]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rainbow trout	LC_{50} 96h	75 mg/L		5
Rat	LD_{50} oral	630 mg/kg		1
Rat	LD_{50} dermal	>5000 mg/kg		1
Guinea pig	LD_{50} oral	600 mg/kg		1
Dog	LD_{50} oral	250-1000 mg/kg		2

[i] TOXICITY (OTHER) — Pelleted bait hazardous to wildlife.[6] Causes posterior paralysis in female rats.[4] Practically non-toxic to aquatic organisms; non-toxic to bees.[6] Unlikely to cause teratogenic effects, non-carcinogenic.[6]

[ii] PHYTOTOXICITY — Non-phytotoxic at recommended rates. The flowers of certain orchids may be injured.[3]

7. METABOLISM

[i] ANIMAL – Metaldehyde ingested by animals is very toxic, frequently causing deaths, and sometimes blindness which may be reversible in survivors.[7]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

White crystalline flammable material with powdery appearance and mild characteristic odour. Warm temperatures give best control. Baits are most effective under arid conditions. Combine with calcium arsenate baits if cloudy, humid conditions are expected after application.[3] Dusts are less effective on snails.[3]

7. REFERENCES

1. PM
2. FCH
3. AC
4. Verschuuren, H.G., R. Kroes, E.M. Den Tonkelaar, J.M. Berkvens, P.W. Helleman and G.J. Van Esch (1975) Long-term toxicity and reproduction studies with metaldehyde in rats. *Toxicology* 4: 97-115.
5. Tomlin, C. The Pesticide Manual. Twelfth Edition, The British Crop Protection Council. 2000. Pg. 606.
6. PP
7. HSDB

Metam

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — metam (Canada, New Zealand) as the free acid (the salt to be stated). The corresponding sodium salt is metam-sodium (before 1990 - E-ISO, F-ISO); karbation (USSR); metham (WSSA); carbam (JMAF for both the ammonium and sodium salts)

[ii] TRADE NAME — Vapam, Busan, Pole-fume (Stauffer Chemical Company)

[iii] CHEMICAL NAME — methyldithiocarbamic acid

[iv] CAS # — 137-42-8

[iv] TYPE / MODE OF ACTION— Soil fumigant for control of weeds, fungi, bacteria, nematodes, weeds, and soil insects. Also used as a remedial wood preservative. The activity of metam is due to its decomposition to methyl isothiocyanate.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Soil fumigant used on many high value crops to sterilize the soil. Used to kill roots of trees growing in sewer pipes and roots forming grafts between trees which may transmit Dutch elm disease and oak wilt. Used to arrest internal decay and to control insects present in Douglas Fir and Red Cedar through the deposition of fungitoxic residues in the cells of the wood. Used on ornamentals and turf.

[i] APPLICATION — Soil is cultivated and kept moist for a week before application. A solution is applied to soil and then the area is sprinkled with water to the depth at which control is desired. SMALL AREAS: May use a sprinkling can or hose proportional dilution. LARGE AREAS: Soil injection, spray application with immediate rotary tiller incorporation, or application through a sprinkler irrigation system.[5] It is most effective if the vapours can be confined with a plastic tarp for 48 hours or more. An alternative is the water seal method (saturating the top 5 cm of soil with water). After 7 days, cultivate to a depth of 5 cm, then seed area after at least another 21 days.[5]

[ii] RATES — 44.0-444 kg/ha. 380 g a.i./30 m^2.

CARRIER: Water.

[iii] FORMULATIONS

1. SL
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 70.3 m
2. Air blast application: Calculated: (85.1) 74.4 m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable with only slight decomposition on storage for several years in glass containers as the 32.7% solution in alkaline water.[4] Unstable on dilution. Pure solid decomposed in several weeks. Decomposes in acid solutions.[4] Non-flammable.[4] Corrosive to aluminum, mild steel and stainless steel, copper, and brass.

4. HANDLING PRECAUTIONS

Use pre-plant only. Do not use in greenhouses where growing plants are present. Do not apply when temperature is over 32°C. Fumes toxic to living plants.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Persists in moist soil for 1-5 hours.[4] The main breakdown product, methyl isothiocyanate, disappears almost completely in 2-3 weeks[4] through vapourization.[3] Can be moved quite readily into soils by leaching. Adsorbed and inactivated by soils containing charcoal.[4] Breaks down in soil by chemical rather than by microbiological means.[4]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1700-1800 mg/kg		2
Mouse	LD_{50} oral	285 mg/kg	Males	4
Rabbit	LD_{50} dermal	2000 mg/kg		4
Mallard	LC_{50} dietary 5d	>5000 mg/kg diet		1
Rainbow trout	LC_{50} 96h	0.079 mg/L		1
Bluegill sunfish	LC_{50} 96h	0.39 mg/L		1
Guppy	LC_{50} 96h	4.2 mg/L		1
Lumbricus (earthworm)		562 L/ha	100% mortality	
		1123 L/ha	100% mortality	
		4493 L/ha	100% mortality	
Helodrilus (earthworm)		562 L/ha	100% mortality	
		1123 L/ha	100% mortality	
		4493 L/ha	100% mortality	

[i] TOXICITY (OTHER) — Irritating to skin, eyes, and mucous membranes.[3]

[ii] PHYTOTOXICITY — Phytotoxic; planting in treated soil must be delayed until decomposition and aeration are complete.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Transformed rapidly to MITC the phytotoxic molecule.[4]

8. ADDITIONAL INFORMATION

Avoid planting until 7-14 days after treatment. If soil is heavy or high in organic matter or the temperature is below 15.5°C then allow 30 days before planting. If dosages are greater than 1122 L/ha allow 60 days before planting. Most effective against weed seeds and underground reproductive systems when soil is approaching a moisture content of field capacity. Success depends on how well soil is prepared. Soil fumigation with metam-sodium in autumn does not appear to affect the persistence of herbicides used the following spring.[6]

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. Klingman, G.C. and F.M. Ashton. Weed Science: Principles and Practices. John Wiley and Sons, New York, 1975. 431 pp.
6. Zandvoort, R. and J.M. Braber (1981) The persistence of some herbicides after soil fumigation with metam-sodium. Proc. EWRS Symp. Theory and Practice of the Use of Soil Applied Herbicides. p. 178-189.

Methamidophos

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — methamidophos (BSI, E-ISO, F-ISO, ANSI)

[ii] TRADE NAME — Monitor (Tomen Corporation)

[iii] CHEMICAL NAME — *O,S*-dimethyl phosphoramidothioate

[iv] CAS # — 10265-92-6

[v] TYPE / MODE OF ACTION — A systemic organophosphorus insecticide and acaricide with contact and stomach action. Cholinesterase inhibitor.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

A contact and residual insecticide/acaricide. Effective over a broad range of insect pests on many crops. Especially useful on cole crops, head lettuce, and potatoes against aphids, mites, leafhoppers, flea beetles, and many species of lepidopterous larvae.

[i] APPLICATION — Apply when insects appear and repeat as necessary, usually at 7-10 day intervals.

[ii] RATES — 0.28-2.43 kg a.i./ha in 200-1000 L (ground) and 10 L+ (air) of water.

CARRIER – Water.

[iii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

See product label. Technical compound and concentrate slightly corrosive to mild steel and copper-containing alloys. Stable at ambient temperature, but decomposes on heating without boiling; stable at pH 3-8, hydrolysed in acids and alkalis.[1]

4. HANDLING PRECAUTIONS

Compatible with most pesticides including oil sprays. Mixing with alkaline sprays should be avoided. Do not graze treated areas. Wear full protective equipment at all times. This includes: neoprene-coated gloves, rubber workshoes or over-shoes, respirator or mask approved for toxic dust and organic vapors, overalls or rubber suit.[4] Do not get in eyes, on skin or clothing. Do not breathe dust. Keep container closed; use with adequate ventilation.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Expected to be highly mobile and readily degraded in soil. Half-life is a few days.[1] Contact effectiveness persists 1-3 weeks.

[ii] AQUATIC - If released to water, volatilization is not expected to occur and methamidophos should not adsorb to sediments or bioaccumulate in aquatic organisms.[4]

[iii] ATMOSPHERIC — Estimated half-life is 4.6 hours (reaction with hydroxyl radicals).[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	15.0-18.0 mg/kg		2
Rat	NOEL 2y	2.0 mg/kg diet		1
Rat	NOEL	1.0 mg/kg b.w.	Maternal & fetal toxicity	3
Rat	NOEL	3.0 mg/kg b.w.	Embryotoxicity & teratogenicity	3
Rat	NOEL dietary	10.0 mg/kg	Reproductive NOEL	3
Mouse	LC$_{50}$ inhalation 1h	276 mg a.i./m3	Male	3
Mouse	LC$_{50}$ inhalation 1h	176 mg a.i./m3	Female	3
Mouse	LC$_{50}$ inhalation 4h	46.2 mg a.i./m3	Male	3
Mouse	LC$_{50}$ inhalation 4h	55.9 mg a.i./m3	Female	3
Guinea pig	LD$_{50}$ oral	30.0-50.0 mg/kg		1
Rabbit	LD$_{50}$ dermal	118 mg/kg		2
Dog	LD$_{50}$ oral	10.0-30.0 mg/kg		1
Dog	NOEL 1y	2.0 mg/kg diet		1
Human	ADI	0.004 mg/kg b.w.		1
Bobwhite quail	LD$_{50}$ oral	8.0-11.0 mg/kg		1
Bobwhite quail	LC$_{50}$ dietary 5d	47.0-57.5 mg/kg diet		1
Mallard	LC$_{50}$ dietary 5d	1000-1302 mg/kg diet		1
Rainbow trout	LC$_{50}$ 96h	25.0-51.0 mg/L		1
Bluegill	LC$_{50}$ 96h	34.0-46.0 mg/L		1
Daphnia	*EC$_{50}$ 48h*	*0.27 mg/L*		*1*

[i] TOXICITY (OTHER) — Rats fed 10.0 mg/kg diets show no effects. None of the metabolites formed in plants or animals considered toxic. The product is harmful to bees. Some injury has been reported on apples. Non-mutagenic, non-oncogenic.

[ii] PHYTOTOXICITY – Non-phytotoxic when used as recommended.[4]

7. METABOLISM

[i] ANIMAL – Male and female rats were each given a single oral dose of ^{32}p-labelled methamidophos at 15.0 mg/kg b.w. After 24 hours, 77% was recovered in the urine. Identified urinary metabolites include phosphoric acid, *S*-methyl thiophosphoric acid, *O,S*-dimethyl thiophosphoric acid, *O*-methyl phosphoric acid amide, and *S*-methyl phosphoramidothroic acid. Unchanged methamidophos and a highly polar unidentified metabolite were also found.[5] Injection of an 8.0 mg/kg dose (toxic, but not lethal) was rapidly distributed throughout the tissues. Within 24 hours, 47% was recovered in the urine and 34% as CO$_2$. Less than 5% was found in faeces over 7 days.[6]

[ii] PLANT – Taken up rapidly and translocated into the leaves with the transpiration flow. Because of rapid degradation in soil, more prolonged uptake via the roots can be expected.[1]

8. ADDITIONAL INFORMATION

Possesses systemic activity. Good residual effectiveness.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HSDB
5. Fakhr, I.M., F.M. Abdel-Hamid and L.M. Afifi *In vivo* metabolism of ^{32}p-Tamaron® in the rat. *Isotope Rad. Res.* 14: 49-55.
6. Gray, A.J., C.M. Thompson and T.R. Fukuto. Distribution and excretion of (^{14}CH$_3$S)-methamidophos after intravenous administration of a toxic dose and the relationship with anticholinesterase activity. *Pest. Biochem. Physiol.* 18: 28-37.

Methomyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — methomyl (BSI, E-ISO, F-ISO, ANSI, ESA, JMAF)

[ii] TRADE NAME — Della, Apavap (Alpha-Laval Inc.); Lannate (DuPont Canada Inc.); Nudrin (Ciba-Geigy Canada Inc.); *Dispar Blue (Dispar Veterinary Products Inc.).*

[iii] CHEMICAL NAME — *S*-methyl-*N*-(methyl-carbamoyloxy)thioacetimidate

[iv] CAS # — 16752-77-5

[v] TYPE / MODE OF ACTION — Carbamate insecticide and nematacide with contact and stomach action.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Broad spectrum control of insects in many vegetable and field crops, certain fruit crops, woodlands and ornamentals. Used as foliar treatment; following soil treatment, taken up by roots and translocated, but this method generally less effective than foliar treatment. Controls aphids, armyworms, cabbage looper, tobacco budworm, and tomato fruitworm.

[i] APPLICATION — Apply when insects appear and repeat as necessary usually at 5-7 day intervals. May be applied with wetting agent.

[ii] RATES — 0.194-2.129 kg a.i./ha in 100-900 L water.

CARRIER: Water, pellet.

[iii] FORMULATIONS

1. GR
2. SN
3. WP
4. PT
5. SO

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: 1-2 m
3. Aerial application:	Calculated: 0 m
4. Forestry application:	Calculated: 0 m

3. STORAGE

Stable as solid or in aqueous solution under normal conditions. Liquid formulations are flammable and non-corrosive. Aeration, sunlight, alkalinity and higher temperatures increase rate of decomposition in water.[4]

4. HANDLING PRECAUTIONS

Keep away from heat, sparks, and open flame. Do not subject liquid to temperatures below 0°C. Do not breathe dust or spray mist. Do not get in eyes, on skin, or on clothing.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Subject to decomposition in moist soil.[3] 50-75% lost after 30 days; only trace quantities left after 90 days.[4] Does not move laterally with run-off.[4] Rapid microbial degradation in soil with CO_2 as principle product.[4]

[ii] AQUATIC — Aeration, sunlight, alkalinity, and higher temperatures increase the rate of decomposition in water.[4]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION — Half-life is 3-7 days. Degraded to CO_2 and acetonitrile which volatilized from plant surfaces. Methomyl itself formed the only residue detected.[4] 70-90% of methanyl residues on tomatoes, peas, and cabbage are removed by cooking and 50-90% of the residues on celery are removed by trimming.[5]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	17.0 mg/kg	Male	2
Rat	LD_{50} oral	24.0 mg/kg	Female	2
Rat	NOEL 2y	100 mg/kg diet		1
Rabbit	LD_{50} dermal	5880 mg/kg	Liquid	2
Dog	NOEL 2y	100 mg/kg diet		1
Human	ADI	0.03 mg/kg b.w.		1
Mallard	LD_{50} oral	15.9 mg/kg		1
Pekin duck	LC_{50} dietary 8d	1890 mg/kg diet		1
Bobwhite quail	LC_{50} dietary 8d	3680 mg/kg diet		1
Rainbow trout	LC_{50} 96h	3.4 mg/L		1
Bluegill	LC_{50} 96h	0.9 mg/L		1
Goldfish	LC_{50} 96h	>0.1 mg/L		3
Daphnia	EC_{50} 48h	28.7 mg/L		1

[i] TOXICITY (OTHER) — No adverse effects noted when field-caged bobwhite quail and albino rabbits were oversprayed 6 times at 5 day intervals with 1.0 kg a.i. in 280 L water/ha.[1] Liquid concentrate may be fatal if swallowed and poisonous if inhaled. Toxic to bees, but is relatively non-toxic once spray has dried.[1] Highly toxic to birds, and aquatic invertebrates; moderately to highly toxic to fish.[6] Non-carcinogenic.[6]

[ii] PHYTOTOXICITY — Non-phytotoxic when used as directed, except to some varieties of apples.[1] Do not apply to spinach in daily temperatures <0°C or to seedlings under 7.6 cm in height.

7. METABOLISM

[i] ANIMAL – Metabolism in rats and plants resulted in rapid complete degradation to CO_2 and acetonitile as major residual products.[4] All radiolabelled 14-C-methomyl eliminated from body within 24 hours as CO_2, acetonitile, and urinary metabolites in ratio of 1:2:1. Approximately 10% of the original dose found in whole body and organs 1 day after treatment.[4]

[ii] PLANT – Rapidly degraded to CO_2 and acetonitrile, with incorporation into natural plant components.[1]

8. ADDITIONAL INFORMATION

Insects fall to ground within minutes of contacting spray. Compatible with other pesticides.

9. REFERENCES

1. PM
2. FCH
3. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
4. W.H.O. (1976) 1975 Evaluations of some pesticide residues in food. W.H.O. Pesticide Residue Series, No. 5: 409 pp.
5. Pesticide Residues in Food, 1986. Evaluation 1986 Part I, Residues. FAO Plant Prod. Prot. Pap. 78: 237-238.
6. PP

Methoprene

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — methoprene (BSI, E-ISO, F-ISO, ANSI, ESA)

[ii] TRADE NAME — Altosid, Apex, Kabat, Precor, Precor 5E Flea Growth Regulator, *Diacon. Dianex, Minex, Ovitrol Plus, Pharoid* all manufactured by Wellmark International. *Zoecon Corporation of Professional Pest Mngt. Div.*.

[iii] CHEMICAL NAME — isopropyl (*E,E*)-(*RS*)-11-methoxy-3,7,11-trimethyldodeca-2,4-dienoate

[iv] CAS # — 40596-69-8

[v] TYPE / MODE OF ACTION— An organic compound with juvenile hormone activity being used as an insect growth regulator. Exhibits morphological rather than direct toxicity against target species.

2. USE PATTERN

Effective against numerous insect pests of plants, stored products, and farm animals. Used against Culicidae [3], cattle-horn flies, indoor fleas, *Megaselia* spp., *Lasioderma serricorne,* and *Ephestia elutella.* Used on food/feed crops, non-cropland, pastures, rangeland, in sewers, waterbodies, and woodlands, fabrics, fibres, and dwellings. Also used in public health (especially against Diptera).

[i] APPLICATION — Prepare diluted spray solution by adding 1 mL Precore 5E to 3.8 L water. Use diluted spray solution within 48 hours. For mosquito control, apply at 2nd, 3rd, and 4th instar larval stage. For fly control feed to cattle and poultry. Apply to tobacco as it goes into storage. May be applied by air. For ant control apply as a bait.

[ii] RATES — 31.0-448 g a.i. in enough water to make 5 to 45 L spray solution per hectare. 0.3 mL a.i./4 L H_2O.

CARRIER – Water.

[iii] FORMULATIONS

1. EC
2. SU
3. TA
4. SN
5. PE

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable in storage. Up to four years of control on stored tobacco. Store in a cool place, away from heat or open flame. Stable in water, organic solvents, and in the presence of aqueous acids and alkalis.[1]

4. HANDLING PRECAUTIONS

Avoid contact with eyes and wash hands after use. Do not use near food or near cooking and eating utensils. Avoid contact with the treated surface until the spray has dried. Keep people and pets away from area during treatment. Do not use in food storage or food production areas. Harmful if swallowed.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Methoprene is of low persistence in soil, reported half-lives are up to 10 days. Rapidly and tightly sorbed to most soils, slightly soluble in water. Unlikeley to be significantly mobile.[8]

[ii] AQUATIC – Degrades rapidly in water.[8]

[iii] ATMOSPHERIC – If released to air methoprene will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase methoprene will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals and ozone; the half-lives for these reactions in air are estimated to be 1.5 hours and 48 minutes, respectively. Methoprene is also expected to rapidly photodegrade in air due to absorption in the environmental spectrum. Particulate-phase methoprene will be removed from the atmosphere by wet and dry deposition.[9]

[iv] PHYTODEGRADATION — Provides almost complete control of *R. dominica* in stored wheat, barley, and corn for > 1 year.[7] Up to four years of control on stored tobacco.[4] Non-persistent. Methoprene applied to fruit such as papaya may persist in the fruit with half-lives ranging from 3 to 15 days, depending on the formulation.[5]

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	>34600 mg/kg		1
Rat	NOEL 2y F.T.	5000 mg/kg diet	No ill effects	1
Mouse	NOEL 2y F.T.	2500 mg/kg diet	No ill effects	1
Rabbit	LD$_{50}$ dermal	3500 mg/kg	Non-irritant to eyes and skin	1
Dog	LD$_{50}$ oral	>5000 mg/kg		1
Human	ADI	0.1 mg/kg b.w.		1
Chicken	LC$_{50}$ dietary 8d	>4640 mg/kg		1
Trout	LC$_{50}$ 96h	4.4 mg/L		1
Bluegill sunfish	LC$_{50}$ 96h	4.6 mg/L		1
Daphnia	*EC$_{50}$ 48h*	*0.36 mg/L*		*1*
Fundulus heteroclitus	*LC$_{50}$ 96h*	*125 mg/L*		*6*

[i] TOXICITY (OTHER) — Toxic to shrimp and crabs, and somewhat toxic to fish [3]. It produces a minimal toxicological effect on maternal Wistar rats, without interference with embryonic differentiation.[2] In two year feeding trials, no methoprene-related effects were observed with rats at 5000 mg/kg dietary and mice at 2500 mg/kg dietary. Non-toxic to adult bees.[1] Slightly toxic to birds, slightly to moderately toxic to fish, non-toxic to earthworms.[8] No effect was observed at the highest rates tested; in 3 generation reproduction studies in rats (2500 mg/kg dietary), teratogenicity in rabbits (500 mg/kg), and mutagenicity in rats (2000 mg/kg).[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In bovids and other mammals, methoprene may be converted to acetate, and then to cholesterol and other natural products (carbon dioxide, protein).[5] A 28-day feeding study at the current approved level of 0.03 mg a.i./kg b.w./day resulted in milk residues of <0.01 mg/kg 2 to 28 days after the beginning of feeding. However, some cows consume up to twice the average supplement intake.[6]

[ii] PLANT – Biodegradable and non-persistent. Plants grown in treated soil are not expected to contain methoprene residues.[8]

8. ADDITIONAL INFORMATION

Not to be combined with other pesticides. Not to be mixed with oil.

9. REFERENCES

1. PM
2. Meister, R.T. Farm Chemicals Handbook '86. Meister Publishing Co., 1986.
3. AC
4. Hackel, C. (1983) Effect of methoprene on the embryonic development of Wistar rats. *Rev. Brasil. Genet.* V1: 639-647.
5. Phonchevin, T. *et al.* (1985) Effects of cyromazin and methoprene on the developmental stages of *Anopheles dirus, Aedes aegypti* and *Culex guinguefasciatus* (Diptera: Culicidae). *Southeast Asian J. Trop. Med. Pub. Hlth.*, 16: 240-247.
6. Quistad, G.B., L.E. Staiger, B.J. Bergot and D.A. Schooley. 1975. Environmental degradation of the insect growth regulator methoprene VII. Bovine metabolism to cholesterol and related natural products. *J. Agric. Food Chem.*, 23: 743-749.
7. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
8. PP
9. HSDB

Methoxychlor

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — methoxychlor (BSI, E-ISO, ESA, JMAF); methoxychlore (F-ISO)

[ii] TRADE NAME — Chipman's Methoxychlor (Chipman Inc.); Marlate (Kincaid Enterprises Inc.); Later's Methoxychlor (Later Chemicals Ltd.); Gerbex; Pyrocide (McLaughlin Gormley King Co.).

[iii] CHEMICAL NAME — 1,1,1-trichloro-2,2-bis(4-methoxyphenyl)ethane

[iv] CAS # — 72-43-5

[v] TYPE / MODE OF ACTION— An organochlorine insecticide and acaricide with long residual activity.

[vi] NOTICE — On April 4, 2002 the US EPA revoked all tolerances for residues of methoxychlor because all registrants were suspended or canceled and insufficient data exists to find the pesticide safe as required by the Federal Food, Drug and Cosmetic Act (FFDCA).

2. USE PATTERN

A non-systemic contact and stomach insecticide with little aphicidal or acaricidal activity. Its range of activity coincides roughly with that of DDT. It shows little or no tendency to be stored in body fat or to be excreted in milk. It is therefore recommended for fly control in dairy barns and on lactating dairy cows. Effective against a wide range of insects affecting fruit, vegetables, ornamentals, forage crops, and livestock. Also used on fabrics and fibre.

[i] APPLICATION — Apply with common application equipment to crops. Start application at first sight of infestation and repeat in 7-14 day intervals as needed. It can be sprayed around livestock premises or directly upon them for control of external parasites. Used also in grain storage bins and in household insect sprays. Used as a seed treatment on a number of grain crops.

[ii] RATES — 0.24-0.56 kg a.i./100m^2-ha; 625-1250 mL a.i./6-7.5 L H_2O; 2.5-12.5 L a.i./30-255 L Diesel fuel.

CARRIER: Diesel fuel.

[iii] FORMULATIONS

1. WP
2. PP
3. DU
4. SU
5. SN

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 40 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Calculated: >1000 m **(aerial application unlikely in Atlantic Canada)**
4.	Forestry application:	Not identified.

3. STORAGE

Methoxychlor is resistant to heat and oxidation and is less readily dehydrochlorinated than DDT by alcoholic alkali. It is susceptible to dehydrochlorination by heavy metal catalysts.

4. HANDLING PRECAUTIONS

Do not use in dipping vats. Do not add grain to a treated bin for at least 24 hours, or until walls have dried out thoroughly. Avoid contamination of fish-bearing waters. Do not use with any product that is incompatible with oil. Do not apply within 14 days of sulphur or sulphur product applications. Compatible with other insecticides and fungicides except strongly alkaline compounds. Wear appropriate chemical protective gloves, boots, and goggles; prevent skin contact.[7]

5. ENVIRONMENTAL PERSISTENCE

Moderately persistent. Long residual action against many insect species.

[i] SOIL — Pila clay loam, 75% residue was left after 3 months. Sandy loam soil plus 3% water showed only trace levels of methoxychlor after 30-38 weeks. The original application was 20.0 mg/kg. Very persistent in soil, half-life approximately 120 days. Tightly bound to soil and insoluble in water therefore not expected to be mobile in moist soils.[6]

[ii] AQUATIC — Half-life of a 40.0 µg/L sample is 7 days. Practcially insoluble in water, adsorbs to sediments and is only slowly released.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION — Half-life on foliage is 21.5 days.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	6000 mg/kg		1
Rat	NOEL 2y	200 mg/kg diet	No effect	1
Mouse	LD_{50}	800 mg/kg		
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Dog	NOEL 1y F.T.	300 mg/kg/d	No toxic effect	1
Mallard	LD_{50} oral	>2000 mg/kg		1
Pheasant	LC_{50} dietary 8d	>5000 mg/kg diet		1
Bobwhite quail	LC_{50} dietary 8d	>5000 mg/kg diet		1
Rainbow trout	LC_{50} 24h	0.052 mg/L		2
Rainbow trout	LC_{50} 48h	0.0072 mg/L		
Goldfish	LC_{50} 96h	0.056 mg/L		
Bluegill sunfish	LC_{50} 24h	0.067 mg/L		1
Mosquito fish	LC_{50} 14h	2.0 mg/L		
Fathead minnow	LC_{50}	0.035 mg/L		
Bass	LC_{50}	0.20 mg/L		
Puffer fish	LC_{50}	0.03 mg/L		
Juvenile white mullet	LC_{50} 48h	0.055 mg/L		
Atlantic silverside	LC_{50} 48h	0.044 mg/L		
Bluehead	LC_{50} 96h	0.013 mg/L		
Yellow perch	96 hours	0.02 -0.03 mg/L		
Striped killifish	LC_{50} 96h	0.03 mg/L		
Striped bass (juvenile)	LC_{50} 96h	0.0033 mg/L		
Guppy	LC_{50} 96h	0.120 mg/L		
Gammarus lacustris	*LC_{50} 24h*	*0.0047 mg/L*		
Sand shrimp	LC_{50} 24h	0.009 mg/L		
Hermit crab	LC_{50} 24h	0.009 mg/L		
Grass shrimp	LC_{50} 24h	0.016 mg/L		
Stonefly	LC_{50} 24h	0.030 mg/L		
Mayfly larvae	TL_{50} 4 wks	0.00022 mg/L		
Mayfly larvae	TL_{50} 96h	0.00196 mg/L		
Brown shrimp	EC_{50} 24h	0.0074 mg/L		
Crayfish	EC_{50} 96h			
American eel	LC_{50}	0.012 mg/L		
Daphnia	*EC_{50} 48h*	*0.00078 mg/L*		*1*

[i] TOXICITY (OTHER) — Low toxicity to humans and warm-blooded animals. Possible carcinogenicity has been suggested.[4] Fatal dose for man estimated at about 454 g.[3] Toxic to fish, aquatic invertebrates and bees. Relatively ineffective against soil organisms.[4] Slightly toxic to bird species[6] Slightly irritating to skin.[7] Non-mutagenic, teratogenic effects in humans are unlikely under normal conditions, unlikely to show carcinogenic activity in humans.[6]

[ii] PHYTOTOXICITY — Rarely phytotoxic; injury usually negligible even on DDT-susceptible crops such as cucurbits.

7. METABOLISM

[i] ANIMAL – Does not accumulate to any significant degree in fat or other tissues of mammals.[6]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Unlike DDT, methoxychlor shows little or no tendency to be stored in the body fat of animals or to be excreted in the milk, therefore recommended for fly control in dairy barns and on lactating dairy cows.[5] Aphids and mites not controlled.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Reuber, M.D. (1980) Carcinogenicity and toxicity of methoxychlor. *Environ. Health Persp.* 36: 205-219.
5. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
6. PP
7. HSDB

Methyl isothiocyanate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The chemical names methyl isothiocyanate (BSI, E-ISO, JMAF) and isothiocyanate de methyle (F-ISO) are accepted in lieu of a common name.

[ii] TRADE NAME — Vorlex, Di-Trapex (Schering AG; Nor-AM Agric. Products Inc.)

[iii] CHEMICAL NAME — methyl isothiocyanate.

[iv] CAS # — 556-61-6

[v] TYPE / MODE OF ACTION — Pre-plant soil fumigant effective against nematodes, fungi, weeds, and insects. 20% methyl isothiocyanate and 80% dichlorpropanes, dichlorpropenes, and related compounds.

[vi] NOTICE — Currently, there are **no end use products registered in Canada**, only one technical. In the United States, methyl isothiocyanate containing products used as soil fumigants were voluntarily removed by registrant in 1992. Currently, methyl isothiocyanate is registered in the US only as a wood preservative pesticide.

2. USE PATTERN

Used in conjunction with other active ingredients (1,3-dichloropropene, chloropicrin)

[i] APPLICATION — Applied in spring or autumn whenever ground can be worked. Keep soil moist until crop residues are well rotted. Loosen soil thoroughly, 1 week before treating, deeper than intended application depth. Soil should be moist to a depth of 15 cm. Cultivate lightly just before treatment, especially if soil is crusted. Inject into soil 15-20 cm deep with chisel or blade applicators 20 cm apart. For weeds only, inject 10-15 cm deep. Firm soil immediately. Tarp seal effective but not compulsory unless soil is >24°C at 15 cm depth.

At 15.5°C or above leave undisturbed for four days. Wet, colder soils need longer fumigation. Allow at least one week. Aerate by cultivation until gas has completely escaped from soil. Usually allow one week between end of exposure period and planting for each 135 L/ha applied.

[ii] RATES — 9.35-180 L a.i./ha.

CARRIER: Not identified.

[iii] FORMULATIONS

1. SN
2. Sometimes formulated with chloropicrin.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 50.3 m
2. Air blast application: Calculated: (63.1) 53.0 m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Moderately corrosive at room temperature, especially to aluminum. Corrosion increases in presence of moisture. Unstable and reactive; rapidly hydrolysed by alkalis, more slowly in acidic and neutral solutions. Sensitive to oxygen and light, stable up to 200°C.[1] Store in a cool, dry place away from sparks; do not store in aluminum containers.[3]

4. HANDLING PRECAUTIONS

Rendered ineffective by stable manure and calcium cyanamide. Do not use near desired plants. Do not use on heavy clay soils. Do not use on dry soil or if temperature in top 7.6 cm is >32°C. Do not plant when odour still present in soil. Common protective clothing such as rubber gloves and boots may be penetrated by the product Vorlex. In case of contact, remove and thoroughly aerate before re-use.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – In damp soil, degradation and evaporation of the bulk of the substance occurs within 3 weeks at 18-20°C soil temperature, 4 weeks at 6-12°C, and 8 weeks at 0-6°C.[1] At lower temperatures, leaching is more significant and is dependant on soil moisture. The potential for groundwater contamination is small, due to low leaching and fast degradation.[1]

[ii] AQUATIC – If released into water, methyl isothiocyanate is not expected to adsorb to suspended solids and sediment based upon the K_{oc} values. Volatilization from water surfaces is expected to be an important fate process. Estimated volatilization half-lives for a model river and model lake are 12 hours and 8 days, respectively.[3]

[iii] ATMOSPHERIC – If released to air methyl isothiocyanate will exist solely as a vapor in the ambient atmosphere. Vapor-phase methyl isothiocyanate will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 118 days. Methyl isothiocyanate absorbs light in the environmental UV spectrum and is therefore susceptible to direct photolysis.[3]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	72.0-220 mg/kg		1
Mouse	LD_{50} oral	90.0-104 mg/kg		1
Rat	LD_{50} dermal	2780 mg/kg		1
Rat	NOEL 2y	0.37-0.56 mg/kg/d		1
Rabbit	LD_{50} dermal	1243 mg/kg		2
Mallard	LD_{50} oral	136 mg/kg		1
Rainbow trout	LC_{50} 96h	0.37 mg/L		1
Bluegill sunfish	LC_{50} 96h	0.13 mg/L		1
Daphnia	*EC_{50} 24h*	*0.06 mg/L*		*1*

[i] TOXICITY (OTHER) — Irritating to eyes and skin (rabbit).[3] Not hazardous to bees when used as directed.[1] Non-carcinogenic.[1]

[ii] PHYTOTOXICITY - Very phytotoxic.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Effective even at soil temperatures of 4.4°C.

9. REFERENCES

1. PM
2. FCH
3. HSDB

Metiram

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — metiram (New Zealand, JMAF); metirame zinc (France). No common name was accepted by ISO (and metiram was withdrawn by BSI) because the product appears to be a mixture rather than a complex.

[ii] TRADE NAME — Polyram (BASF Canada Inc.)

[iii] CHEMICAL NAME — zinc ammoniate ethylenebis(dithiocarbamate)-poly(ethylenethiuram disulphide)

[iv] CAS # — 9006-42-2

[v] TYPE / MODE OF ACTION — A carbamate compound used as a protective foliar fungicide. Consists of 83.9% ammoniates of ethylene bis (dithiocarbamate)-zinc + 16.1% ethylene bis-dithiocarbamic acid bimolecular and trimolecular cyclic anhydrosulphides and disulphides.

2. USE PATTERN

This non-systemic fungicide is used against many diseases, particularly against Early and Late Blight, Downy Mildew, Apple Scab, seed borne diseases on potato, cereals and flax turf diseases. Acts as a source of zinc in zinc-deficient soils and also acts as a mite suppressant.[2] Also used on stored food, feed, and seed.

[i] APPLICATION — As a seed piece treatment on potatoes, apply to foliage when necessary and repeat every 7-10 days throughout the growing season. Thorough coverage is important. Treat right up to the time of harvest.[2]

[ii] RATES — Apple, 4.8 kg a.i./ha. Potato, 0.89-1.80 kg a.i./ha (foliar); 70.0-105 g a.i./100 kg seed.[3]

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. DU
3. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Calculated: 4(8)-7(15) m
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

Unstable under strongly alkaline or acidic conditions. If combined with insecticides such as malathion and diazinon, it should be applied immediately. Stable at 30°C. Slowly decomposed by light; non-hygroscopic.[1]

4. HANDLING PRECAUTIONS

Compatible with parathion but not with parathion oil sprays. Must be stored in a cool, dry place to avoid release of flammable vapours and chemical changes. Incompatible with highly alkaline materials.[1]

5. ENVIRONMENTAL PERSISTENCE

Has a relatively long residual life. Breakdown products in soil, water, and biota include thiourea, ethylenethiourea, and sulphur.

[i] SOIL – Low persistence in soil, strongly bound to most soils; probably does not pose a significant risk to groundwater.[5] Volatilization from moist soil surfaces is not expected to be an important fate process. Metiram is not expected to volatilize from dry soil surfaces based upon its vapor pressure.[4]

[ii] AQUATIC — Breakdown is rapid by hydrolysis and biodegradation. Bioconcentration in aquatic organisms may be important. Metiram is expected to adsorb to sediment and suspended solids in water based upon the K_{oc}. Volatilization from water surfaces is not expected to be an important fate process.[4]

[iii] ATMOSPHERIC – If released to air metiram will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase metiram will be removed from the atmosphere by wet and dry deposition.[4]

[iv] PHYTODEGRADATION –

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>6180->10000 mg/kg		5
Rat	NOEL 2y	3.1 mg/kg		1
Rat	LD_{50} dermal	>2000 mg/kg		4
Mouse	LD_{50} oral	>5400 mg/kg		1
Dog	NOEL 90d	45.0 mg/kg/d		4
Mallard	LC_{50} 5-8d	3712 ppm		5
Rainbow trout	LC_{50} 96h	1.1 mg/L		5
Harlequin fish	LC_{50} 24h	32.0 mg/L		4
Harlequin fish	LC_{50} 48h	17.0 mg/L		1
Carp	LC_{50} 96h	85.0 mg/L		1

[i] TOXICITY (OTHER) — Toxic to fish. Non-toxic to bees (LD_{50} oral >40.0 ug/bee).[1] Slightly toxic to birds.[1] Reproductive effects are unlikely in humans under normal circumstances; no teratogenic effects found in female rats, non-mutagenic.[5]

[ii] PHYTOTOXICITY - Non-phytotoxic at spray concentrations.[2]

7. METABOLISM

[i] ANIMAL – Not well-absorbed through the skin. In rats, residues remain in the kidneys, thyroid, and gastrointestinal tract.[5]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Ineffective once fungi are established in plant.[2] Does not possess eradicative properties.[2] Acts as safener for lead arsenate on apples.[2]

9. REFERENCES

1. PM
2. AC
3. PMRA
4. HSDB
5. PP

Metobromuron

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — metobromuron (BSI, E-ISO, F-ISO, ANSI, WSSA)

[ii] TRADE NAME — Patoran (Ciba-Geigy Canada Ltd.); Other names include Galex (metobromuron + metolachlor) and Pattonex.

[iii] CHEMICAL NAME — 3-(4-bromophenyl)-1-methoxy-1-methylurea.

[iv] CAS # — 3060-89-7

[v] TYPE / MODE OF ACTION — A substituted urea compound used as a selective pre-emergence herbicide. Inhibits photosynthesis.

2. USE PATTERN

For the control of lambsquarters, smartweed, bluegrass, chickweed, mustards, nightshade, crabgrass, barnyard grass, green foxtail, and others. For use on beans, potatoes, soybeans, tobacco and tomatoes. It is most effective on broadleaved weed species.[2]

[i] APPLICATION — Applied as a pre-emergence herbicide immediately after planting. On tobacco, it may be applied 5 days prior to transplanting. Moisture is required to move the material into the soil. Rainfall that gives sufficient moisture to germinate seeds or for growing crops is adequate to activate this chemical. If the weather is dry, shallow cultivation will help to move the chemical into lower, moist soil. This product may be applied either as an overall spray or as a band treatment. Do not use on extremely sandy or high organic matter soil.

[ii] RATES — 1.125-3.375 kg a.i/ha, depending on the soil type (lower rates in light sandy soil and higher rates in muck soil).

CARRIER: At least 450L water.

[iii] FORMULATIONS

1. WP
2. SU
3. EC

[iv] SUGGESTED AQUATIC BET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store in a cool dry place. Keep from contact with fertilizers, insecticides, fungicides, and seeds. Very stable in neutral, dilute acid and dilute alkaline meida; hydrolysed by strong acids and alkalis.[1]

4. HANDLING PRECAUTIONS

Do not breath spray mist. Avoid contact with skin or eyes. Do not contaminate food/feed or streams, ponds, and lakes with this product.

5. ENVIRONMENTAL PERSISTENCE

Metobromuron gives approximately 8 weeks of weed control.

[i] SOIL — Moderate mobility in soil. Half-life is approximately 30 days.[1] Biodegradation and photodegradation may be important fate processes. Strongly bound to soil indicating low leaching potential.[1] Volatilization of metobromuron should not be important from moist or dry soil surfaces. Metobromuron may photolyze on soil surfaces. According to a variety of pure culture biodegradation studies, including biodegradation in plants, algae, and fungi, metobromuron may biodegrade in soil and water.[3]

[ii] AQUATIC – Stable to abiotic degradation.[1] If released to water, metobromuron may adsorb to suspended solids and sediment. Metobromuron will be essentially non-volatile from water surfaces.[3]

[iii] ATMOSPHERIC – If released to the atmosphere, metobromuron will exist as a vapor in the ambient atmosphere. Vapor-phase metobromuron is degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of about 28 hours. Particulate-phase metobromuron may be physically removed from the air by wet and dry deposition.[3]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	2603 mg/kg		1
Rat	LD_{50} dermal	>3000 mg/kg		1
Rat	LC_{50} inhalation 4h	>1.1 mg/L air		1
Rat	NOEL 2y	17.0 mg/kg/d		1
Dog	NOEL 2y	3.0 mg/kg/d		1
Mallard	LD_{50}	6643 mg/kg		1
Japanese quail	LD_{50}	1429 mg/kg		1
Rainbow trout	LC_{50} 96h	36.0 mg/L		1
Crucian carp	LC_{50} 96h	40.0 mg/L		1
Bluegill sunfish	LC_{50} 96h	40.0 mg/L		1
Goldfish	LC_{50} 96h	71.0-85.0 ppm		3
Daphnia	*EC_{50} 48h*	*44.0 mg/L*		*1*

[i] TOXICITY (OTHER) — Metobromuron is slightly toxic to birds and practically non-toxic to honeybees (LD_{50} >160 ug/bee).[1] Slightly toxic to fish. Not a skin or an eye irritant (rabbits).[1]

[ii] PHYTOTOXICITY — Some bean and tobacco varieties will be injured.[2] Certain crops will be injured if planted within one year following application of this material.[2] Generally, at recommended dosages, it is degraded to non-phytotoxic levels within 90 days.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Absorbed by roots and leaves.[3]

8. ADDITIONAL INFORMATION

On beans, excessively heavy rainfall on light sandy soils may leach metobromuron into the root zone, resulting in crop injury. Alternatively, heavy driving rain may "splash-up" the chemical, causing injury to young seedlings. Rotary hoeing to break up crusted soil minimizes the risk of this injury.

9. REFERENCES

1. PM
2. AC
3. HSDB

Metolachlor

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — metolachlor (BSI, E-ISO, ANSI, WSSA); metolachlore (F-ISO)

[ii] TRADE NAME — Dual, Primextra (Novartis Crop Protection Canada Ltd.); Dualin (Ciba-Geigy); Checkmate (United Agri Products)

[iii] CHEMICAL NAME — 2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide

[iv] CAS # — 51218-45-2

[v] TYPE / MODE OF ACTION — Selective herbicide which inhibits germination.

2. USE PATTERN

Pre-emergence and pre-plant incorporated weed control in corn. Also applied to soybeans, pod crops, peanuts, fruit crops, and potatoes. Germination inhibitor active mainly on grasses. Used in combination with atrazine for weed control in corn and sugarcane. Also used in non-crop weed control.

[i] APPLICATION — Either pre-emergence or pre-plant incorporated. If rainfall does not occur within 10 days, incorporate lightly. Under furrow irrigation it can be pre-plant incorporated in top 5 cm of soil. May be applied 30 days prior to planting. May be applied by air or through centre pivot irrigation equipment.[3] May be applied at early post-emergence in corn.

[ii] RATES — Corn, soybean, potato, 1.68-2.64 kg a.i./ha. [4]

CARRIER: Not identified.

[iii] FORMULATIONS

1. EC
2. SN
3. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 50 m (product containing flumetsulam (28g/L), metolachlor (895 g/L)).
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Shelf-life of 3-5 years under minimum storage temperatures.[2] Stable up to approximately 275°C. Hydrolysed by strong alkalis and strong mineral acids.[1]

4. HANDLING PRECAUTIONS

Do not plant any crop other than corn for 18 months after treatment.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Moderately persistent in soil. Microbial degradation is the major fate process. Some loss may occur from soil surface due to photolysis.[5] Half-life in soil is c. 30 days.[1] May leach to groundwater in soils with low organic matter.

[ii] AQUATIC — Highly persistent in water over a wide range of water acidity.[7] Half-life at 20°C ranges from 90-200 days.[7] Relatively stable in water under natural sunlight.[7]

[iii] ATMOSPHERIC - If released to air, a vapor pressure of 3.14X10-5 mm Hg at 25°C indicates metolachlor will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase metolachlor will be degraded in the atmosphere by reaction with photochemically- produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 7 hours. Particulate-phase metolachlor will be removed from the atmosphere by wet and dry

deposition. Metolachlor absorbs light in the environmental UV spectrum and has the potential for direct photolysis in the atmosphere with reported half-lives of 8-22 days.[5]

[iv] PHYTODEGRADATION — Rapidly metabolized in plants.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	2780 mg/kg		6
Rat	LC_{50} inhalation 4h	>1.75 mg/L		1
Rat	NOEL 90d	300 mg/kg diet		1
Rabbit	LD_{50} dermal	>10,000 mg/kg		2
Dog	NOEL 90d	12.5 mg/kg/d		1
Mallard	LD_{50} oral	>2150 mg/kg		1
Bobwhite quail	LD_{50} oral	>4500 mg/kg		7
Bobwhite quail	LC_{50} dietary 8d	>10000 mg/kg		1
Rainbow trout	LC_{50} 96h	2.0 mg/L		5
Bluegill sunfish	LC_{50} 96h	15.0 mg/L		1
Carp	LC_{50} 96h	4.9 mg/L		1
Channel catfish	LC_{50} 96h	4.9 ppm	Technical grade	5
Daphnia	*EC_{50} 48h*	*25.0 mg/L*		*7*

[i] TOXICITY (OTHER) — Slightly to practically non-toxic to birds.[7] Eye and skin irritation in rabbits ranges from non-irritating (tech. prod.) to moderate (formulations). Non-toxic to honey bees (LD_{50} oral/contact >110 μg/bee).[1] Slightly to moderately toxic to fish. Not likely to have an effect on reproduction in humans under normal circumstances; teratogenic and developmental effects in humans are unlikely at expected levels of exposure; non-mutagenic; unlikely that metolachlor is carcinogenic in humans.

[ii] PHYTOTOXICITY — Injury may occur on yams under abnormally high soil moisture conditions.[3] Well tolerated by most broad-leaved crops, maize, sorghum.[1]

7. METABOLISM

[i] ANIMAL - In rats, 70-90% of an oral dose was excreted within 48 hours.[7]

[ii] PLANT – Metabolism involves natural product conjugation of the chloroacetyl group, and hydrolysis and sugar conjugation at the ether group. Final metabolites are polar, water-soluble, and non-volatile.[1]

8. ADDITIONAL INFORMATION

Can be tank mixed with liquid fertilizers or impregnated with dry fertilizer.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. CESARS
7. PP

Metribuzin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — metribuzin (BSI, E-ISO, WSSA); metribuzine (F-ISO)

[ii] TRADE NAME — Sencor, Conquest, Axiom DF (Bayer Inc. Ag. Div.); Lexone, Fire DF (DuPont Canada Inc); Evict (United Agri Products).

[iii] CHEMICAL NAME — 4-amino-6-(1,1-dimethylethyl)-3-(methythio)-1,2,4-triazin-5(4*H*)-one

[iv] CAS # — 21087-64-9

[v] TYPE / MODE OF ACTION — A triazine compound used as a selective pre- and post-emergence herbicide. Inhibits photosynthesis.

[vi] NOTICE — In January of 2002, US EPA revoked certain residue tolerances for metribuzin due to the cancellation of food usages for metribuzin containing products.

2. USE PATTERN

For control of many grasses and broadleaved weeds in alfalfa, asparagus, and potatoes. For control of cocklebur, velvet leaf, jimson weed, teaweed, and sicklepod.

[i] APPLICATION — Pre-emergence and early post-emergence applications have given best results. Pre-plant incorporated applications have also shown promise on tomatoes, soybeans, sorghum and corn. Pre-emergence applications may be broadcast or banded. Best results are obtained with pre-emergence sprays if moisture is supplied within 2 weeks after application.[5] SOYBEANS, a post-emergence application applied as a direct spray may be made.[3]

[ii] RATES — 0.158-2.06 kg a.i./ha in 150-300 L water.

CARRIER: Water at 112-450 L/ha.

[iii] FORMULATIONS

1. WP
2. SU
3. SG
4. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Label: 15 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Estimated shelf life is in excess of 2 years under normal storage conditions. Non-flammable and non-corrosive. Relatively stable to ultraviolet irradiation. At 20°C, stable to dilute acids and alkalis.[1]

4. HANDLING PRECAUTIONS

Avoid contact with eyes, skin, and clothing. Avoid breathing dust or spray mist. Wash thoroughly after use. Do not contaminate food or feed. Do not use on sandy or sandy loam soils with less than 2% organic matter or on muck or high organic content soils. Compatible with most other herbicides, except in highly concentrated mixtures.[1]

5. ENVIRONMENTAL PERSISTENCE

Control should last 3-4 months.[3]

[i] SOIL — Rapidly degraded through both microbial and non-microbial means.[7] Half-life in various soil types is 17-60 days, depending on temperature, pH and soil type. Readily adsorbed in soils with high clay/organic content. An increase in pH causes an increase in rate of degradation (due to decreased adsorption).[6] Soils which favour growth of

soil microorganisms will show an increased rate of breakdown. Breakdown occurs fastest under aerobic conditions in the presence of sunlight.[4]

[ii] AQUATIC – If present, metribuzin would most likely be found in the water column rather than the sediment due to its low binding affinity and high water solubility.[8]

[iii] ATMOSPHERIC – If released to air metribuzin will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase metribuzin will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 21 hours. Particulate-phase metribuzin will be removed from the atmosphere by wet and dry deposition. Metribuzin absorbs light in the environmental UV spectrum and has a photolysis half-life of 2.5 days on sandy loam soil irradiated outdoors.[9]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1100-2300 mg/kg	Technical grade	2
Rat	NOEL 2y	100 mg/kg diet		1
Rabbit	LD_{50} dermal	>20,000 mg/kg		2
Mallard	LD_{50} oral	460-680 mg/kg		1
Bobwhite quail	LD_{50} oral	168 mg/kg		1
Bobwhite quail	LC_{50} dietary 5d	>4000 mg/kg diet		1
Rainbow trout	LC_{50} 96h	64.0 mg/L		1
Bluegill sunfish	LC_{50} 96h	80.0 mg/L		1
Goldfish	LC_{50} 96h	>10.0 mg/L		2
Daphnia	*EC_{50} 48h*	*4.5-35.0 mg/L*		*1*

[i] TOXICITY (OTHER) — May be harmful if swallowed or inhaled. Does not cause eye or skin irritation or sensitization. Low toxicity to fish and birds. Not toxic to bees.[1] Does not cause reproductive effects, non-mutagenic, non-carcinogenic and does not cause teratogenic effects in humans under normal circumstances.[8]

[ii] PHYTOTOXICITY — May be phyto-toxic to non-target plant species.[8] Sensitive plants include crucifers, cucumbers, flax, peas, strawberries, sugarbeets, sunflowers, sweet potatoes, tobacco, and other rotation crops.

7. METABOLISM

[i] ANIMAL – Following oral administration in mammals, 98% elimination occurs within 96 hours, about equally in the urine and faeces.[1]

[ii] PLANT - In plants, major routes of detoxification are the actions of sunlight oxidation and the conversion to water conjugates.

8. ADDITIONAL INFORMATION

Water solubility is 1200 mg/L. May be mixed with other herbicides.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. PMRA
6. Ladlie, J.S., W.F. Meggitt and D. Penner (1976) Role of pH on metribuzin dissipation in field soils. *Weed Sci.* 24: 508-511.
7. Savage, K.E. (1977) Metribuzin persistence in soil. *Weed Sci.* 25: 55-59.
8. PP
9. HSDB

Metsulfuron-methyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — metsulfuron (BSI, WSSA, draft E-ISO, draft F-ISO); metsulfuron-methyl (ANSI)

[ii] TRADE NAME — Ally, Escort, Gropper (DuPont Chemicals)

[iii] CHEMICAL NAME — 2-(4-methoxy-6-methyl-1,3,5-triazin-2-ylcarbamoylsulphomyl)benzoic acid.

[iv] CAS # — 74223-64-6

[v] TYPE / MODE OF ACTION — Herbicide. Rapidly absorbed by foliage and roots and translocated both basipetally and acropetally. Selectivity is due to rapid hydrolysis within cereal plants.

[v] NOTICE — **No metsulfuron-methyl containing products currently registered for use in the Atlantic provinces.**

2. USE PATTERN

Effective against a wide range of weeds in cereals. Selective pre-emergence and post-emergence in wheat and post-emergence in barley, against *Apera spica-venti, Lolium, Polygonium, Viol* spp., and *Veronica persica.* Also used on pastures and rangeland.

[i] APPLICATION — Do not apply by air. Not for use on lawns, walks, driveways, tennis courts, or similar areas. Surfactant may be required.

[ii] RATES — 3.5 g a.i./ha in 100-1000 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. WG
3. SG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 15-45 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store in a cool dry area. Non-corrosive, non-flammable, and non-volatile. Does not freeze. Stable in air up to approximately 140ºC.[1]

4. HANDLING PRECAUTIONS

Wash hands before eating or smoking.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Degraded by hydrolysis, with a 50% loss in 7-30 d. It has been found that dissipation is greater in acidic soils than alkaline (*e.g.*, The reported half-life in clay (pH 7.5), sandy loam (pH 6.8) and clay loam (pH 5.2) soils was 178, 102, and 70 days, respectively.[2]

[ii] AQUATIC — Hydrolyzed in acidic solution at 25°C with a 50% loss at 15 hours at pH 2, 33 days at pH 5 and >41 days at pH 7-9. Hydrolysis was more rapid at 45°C.

[iii] ATMOSPHERIC –Metsulfuron-methyl can be expected to exist almost entirely in the particulate phase in the ambient atmosphere.[3]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg	Males and females	1
Mallard	LD_{50} oral	>5000 mg/kg		1
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Rat	LC_{50} inhalation 4 h	>5.0 mg/L air	Males and females	1
Rat	NOEL 2y	50.0 mg/kg diet		1
Dog	NOEL 2y	200 mg/kg diet		1
Rainbow trout	LC_{50} 96h	>150 mg/L		1
Bluegill sunfish	LC_{50} 96h	>150 mg/L		1
Daphnia	*EC_{50} 48h*	*>150 mg/L*		*1*

[i] TOXICITY (OTHER) —It is a mild skin irritant to guinea pigs but is not a skin sensitizer. A moderate but reversible eye irritant. Non-toxic to bees.[1] Non-mutagenic, non-teratogenic.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In mammals, following oral administration, metsulfuron-methyl is excreted predominantly unchanged.[1]

[ii] PLANT – Undergoes complete degradation within a few days, by hydrolysis and conjugation.[1]

8. ADDITIONAL INFORMATION

None Identified.

9. REFERENCES

1. PM
2. Smith, A.E (1986) Persistence of the herbicides $[^{14}C]$ chlorsulfuron and $[^{14}C]$ metsulfuron methyl in prairie soils under laboratory conditions. *Bull. Environ. Contam. Toxicol.* 37: 698-704.
3. HSDB

Mineral Oil

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — mineral oil

[ii] TRADE NAME — Superior Oil 70 (Wilbur-Ellis Company of Canada Ltd.)

[iii] CHEMICAL NAME — mineral oil

[iv] CAS # — 8012-95-1

[v] TYPE / MODE OF ACTION — A mixture of liquid hydrocarbons from petroleum, mineral oil is used as a surfactant with herbicidal and insecticidal properties.

2. USE PATTERN

Used to control scale insects, red spider mites, and mealybugs on dormant shrubs, woody plants, and fruit trees. Used in tank mixes in canola, flax, and soybeans, and often used with atrazine formulations to control emerged broadleaf weeds and annual grasses in corn.

[i] APPLICATION — Broadcast or overall post-emergence spray.

[ii] RATES — Corn, 1.04 L a.i. in 100 L water, tank mixed with atrazine. Apple, pear, 18.95 L a.i. in 1000 L water. Ornamentals, 2.37 L a.i. in 100 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. SN
3. LI

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Oxidation and peroxidation when it occurs in mineral oils continues almost at logarithmic rate.[1]

4. HANDLING PRECAUTIONS

Wear appropriate personal protective clothing to prevent skin contact including: goggles or face shield.[1] Contaminated protective clothing should be segregated in such a manner so that there is no direct personal contact by personnel who handle, dispose, or clean the clothing.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

[i] TOXICITY (OTHER) - Not identified.

[ii] PHYTOTOXICITY - Not identified.

7. METABOLISM

[i] ANIMAL– Mineral oil mists derived from highly refined oils and several formulated products appear to have a low acute and low sub-acute toxicity in animals. Single and short term repeated exposures (up to six months) to relative high concentrations (well in excess of 100 mg/cu m) have resulted in lung inflammatory reaction, lipoid granuloma formation, and lipoid pneumonia.[1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. HSDB

Monolinuron

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — monolinuron (BSI, E-ISO, F-ISO, WSSA)

[ii] TRADE NAME — Afesin (Aventis CropScience Canada Co.); Pfizer (Pfizer C and G Inc.)

[iii] CHEMICAL NAME — 3-(4-chlorophenyl)-1-methoxy-1-methylurea

[iv] CAS # — 1746-81-2

[v] TYPE / MODE OF ACTION — Substituted urea compound used as a pre- and post-emergence systemic herbicide. Kills plants by the inhibition of photosynthesis. Uptake is both through the roots and leaves. It has a relatively high vapour pressure compared with other urea compounds so uptake via the stems is possible.

2. USE PATTERN

On potatoes, dwarf beans, asparagus, cereals, ornamentals, grapes, berries, and certain other crops. Used to control many annual broadleaves and grasses.[3]

[i] APPLICATION — Post-emergence application should be made while weeds are still young.[3] Applied to potatoes prior to their emergence; to other crops post-emergence. Apply to damp soil as a pre-emergence application.[3]

[ii] RATES — 0.7-2.2 kg/ha.

CARRIER: Not identified.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

2. Ground application:	Calculated: 0 m
3. Air blast application:	Not identified.
4. Aerial application:	Not identified.
5. Forestry application:	Not identified.

3. STORAGE

Stable at its melting point and in solution but slowly decomposes in acids and bases. Non-corrosive. Very stable in dry, neutral conditions. Degradation is accelerated by ultraviolet light; decomposes at 220°C.[1]

4. HANDLING PRECAUTIONS

Do not use on soils high in organic matter.

5. ENVIRONMENTAL PERSISTENCE

At 2.5 kg/ha, 60% lost by evaporation during first year.[6] Residues in edible parts of potatoes very low compared with vegetative parts in year 1; some residue found in plants even in year 5.[6]

[i] SOIL — Residues found in nearly all soil layers, to depth of 20 cm.[6] Relatively low vapour pressure; not very volatile from soil.[4] Moderately mobile in soil. Adsorption, mobility, and activity not affected by soil pH.[4] In most soils, degraded to herbicidal inactivity in 2-3 months.[5] Biodegradable.[5] Repeated use may accelerate soil degradation, probably by accumulation of specific microorganisms.[5] Demethylation and demethoxylation processes yield metabolites which are hydrolyzed to 3,4-dichloroaniline and 4-chloroquiline.[5]

[ii] AQUATIC – If released to water, monolinuron may adsorb to suspended solids and sediment according to experimental K_{oc} values of 40-2025. Monolinuron will be essentially non-volatile from water surfaces. The half-life of monolinuron in water has been determined to be 22 days.[8]

[iii] ATMOSPHERIC – If released to the atmosphere, monolinuron will exist as a vapor in the ambient atmosphere. Vapor-phase monolinuron is degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of about 27 hours. Particulate-phase monolinuron may be physically removed from the air by wet and dry deposition.[8]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	2100-2215 mg/kg	Female	2
Rat	LD_{50} oral	1493 mg/kg	Female; peanut oil carrier	5
Rat	LD_{50} oral	1715 mg/kg	Male; peanut oil carrier	5
Rat	LD_{50} oral	1949 mg/kg	Female; gelatin suspension	5
Rat	LC_{50} inhalation 4h	>3.39 mg/L air		1
Rat	LD_{50} dermal	71500 mg/kg		5
Rat	NOEL 2y	250 mg/kg diet		1
Rat	90d F.T.	250-2500 mg/kg	Dose-dependent retardation of body weight >500 mg/kg. Reduces hemoglobin & red cell count at 2500 mg/kg.	5
Cat	LD_{50} oral	2239 mg/kg	Male; gelatin suspension	5
Cat		20.0 mg/kg	Weight loss	5
Cat		200 mg/kg	Vomiting, death within 48h	5
Human	ADI	0.014 mg/kg b.w.		1
Bobwhite quail	LD_{50} oral	1260 mg/kg		1
Mallard	LD_{50} oral	>500 mg/kg		1
Chicken	LD_{50} oral	242 mg/kg	Gelatin suspension	5
Rainbow trout	LC_{50} 96h	56.0-75.0 mg/L		1
Carp	LC_{50} 96h	74.0 mg/L		1
Goldfish	LC_{50} 24h	50.0 mg/L		5
Idus melanotus	*LC_{50} 24h*	*65.0 mg/L*		*5*
Xiphophorus helleri	*LC_{50} 24h*	*20.0 mg/L*		*5*
Lebistes reticulata	*LC_{50} 24h*	*55.0 mg/L*		*5*
Lymnaea	*LC_{50} 24h*	*85.0 mg/L*		*5*
Tubifex	*LC_{50} 24h*	*90.0 mg/L*		*5*
Daphnia	*EC_{50} 48h*	*32.5 mg/L*		*1*
Mosquito larvae	LC_{50} 24h	120 mg/L		5

[i] TOXICITY – Harmless to beneficial species.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

Phenylurea herbicides are readily metabolized by most biological systems. Degradative reactions include N-dealkylation, N-dealkoxylation, ring hydroxylation, oxidation of ring substituents, and a small amount of aniline formation.

[i] ANIMAL – Not identified.

[ii] PLANT – Degradation in plants is similar to that in soil.[1] Absorbed by leaves and roots[8]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. Doull, J., C.D. Klassen and M.O. Amdus (1980) *Casarett and Doull's Toxicology*. Macmillan Publ. Co. Inc., New York, 778 pp.
6. Maier-Bode, H. and K. Hartel (1981) Linuron and monolinuron. *Residue Reviews* 77: 1-352.
7. Sotiriou, N. and W. Klein (1981) Ein Langzeitversuch mit Nomolinuron-(phenyl-^{14}C) unter Freilandbedingungen (Long-term experiment with (phenyl-^{14}C)-monolinuron under field conditions) *Chemosphere* 10: 147-152.
8. HSDB

Napropamide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — napropamide (BSI, E-ISO, F-ISO, WSSA, JMAF)

[ii] TRADE NAME — Devrinol (Syngenta Crop Protection Canada, Inc.) (United Phosphorus Inc.)

[iii] CHEMICAL NAME — (*RS*)-*N*,*N*-diethyl-2-(1-naphthyloxy)propionamide

[iv] CAS # — 15299-99-7

[v] TYPE / MODE OF ACTION — A propionamide compound used as a selective pre-emergence herbicide. Napropamide inhibits growth and development of the roots of grass weeds.[4] In the tomato it is taken up by the roots within 8 hours, and translocated upward through the stems and leaves.[4]

2. USE PATTERN

[i] APPLICATION — Soil treatments should be incorporated into the soil within two days of application. For pre-emergence surface treatments applied to weed-free soil irrigate if no rain falls within two days.[5] Avoid contact with fruit and foliage. Do not use on soil with over 10% organic matter.[2]

[ii] RATES — SOIL TREATMENTS: 2.0-4.0 kg a.i./ha. SURFACE TREATMENTS (pre-emergence): 3.0-6.0 kg a.i./ha. CROPLAND USE: 1.1-8.9 kg a.i./ha. This chemical should be applied with a low pressure beam-type sprayer in 200-900 L water/ha.

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. WP
3. GR
4. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Stable for several years in packages.[3] No decomposition observed at 40°C in 63 days at $4<pH<10$.[5] Non-corrosive.[3] Store in a cool, dry place. Decomposed by sunlight.[1]

4. HANDLING PRECAUTIONS

None identified.

5. ENVIRONMENTAL PERSISTENCE

Napropamide decomposes under U.V. light.[3]

[i] SOIL — Relatively long-lasting (more than 9 months under some conditions). Therefore, it may cause injury to crops following use.[4] In moist, loamy sand and loam soils at -5.5-0°C the half-life is about 8-12 weeks.[4] Very little loss by volatilization from soil surface, but under the high intensity sunlight of summer over 50% may be lost by photodecomposition after four days.[3] Slowly decomposed by soil microorganisms.[3, 4] Napropamide is quite resistant to leaching in most mineral soils.[4]

[ii] AQUATIC – Broken down rapidly; mediated by the action of sunlight (photolysis).[6] The half-life may be as rapid as 7 minutes.[6] If released into water, napropamide is expected to adsorb to suspended solids and sediment based upon the reported K_{oc}s. Volatilization from water surfaces is not expected to be an important fate process. Direct photolysis in sunlit surface waters is expected to be an important environmental fate process.[7]

[iii] ATMOSPHERIC – If released to air napropamide will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase napropamide will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 2 hours. Particulate-phase napropamide will be removed from the atmosphere by wet and dry deposition.[7]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg tech/kg	Males	3
Rat	LD_{50} oral	4680 mg/kg	Females	1
Rabbit	LD_{50} dermal	>4640 mg/kg		1
Dog	NOEL 90d	40.0 mg/kg/d		1
Rainbow trout	LC_{50} 96h	16.6 mg/L		1
Bluegill sunfish	LC_{50} 96h	30.0 mg/L		1
Goldfish	LC_{50} 96h	>10.0 mg/kg		3
Daphnia	*EC_{50} 48h*	*24.0 mg/L*		*1*

[i] TOXICITY (OTHER) — Toxic to fish.[2] Moderate eye irritant; not a skin irritant.[1] Non-toxic to game birds, non-toxic to bees.[6] Negative genotoxicity; non-oncogenic.[1] Non-mutagenic, not likely to be carcinogenic.[6]

[ii] PHYTOTOXICITY – Phytotoxic to wheat and barley.[1]

7. METABOLISM

[i] ANIMAL – In mammals, following oral administration, napropamide is rapidly and extensively metabolized. The majority of the dose is excreted via urine and faeces.[1]

[ii] PLANT - The major metabolites within the plant system are hexose conjugates of 4-hydroxy napropamide.[4] Rapidly metabolized, followed by conjugation with sugars to produce water-soluble metabolites.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. AC
3. HH
4. Klingman, G.C. and F.M. Ashton. Weed Science: Principles and Practices. John Wiley and Sons, New York, 1975. 431 pp.
5. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
6. PP
7. HSDB

Naptalam

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — naptalam (BSI, E-ISO, WSSA); naptalame (F-ISO); alanap (former exception, Turkey); NPA for sodium salt (JMAF)

[ii] TRADE NAME — Alanap (Crompton Co.)

[iii] CHEMICAL NAME — *N*-1-napthylphthalamic acid (sodium salt)

[iv] TYPE / MODE OF ACTION — Selective, pre-emergence phthalic acid herbicide.

2. USE PATTERN

Inhibits seed germination in many broadleaves and grasses. Recommended as a pre-emergence herbicide in cucurbits, soybeans, and asparagus. Not effective on emerged weeds.[6]

[i] APPLICATION — Planter-mounted pre-emergence herbicide sprayer or granular applicator preferred for application. Soil surface should be smooth and free from lumps.[5] Do not use on extremely high peat muck soils. Do not apply on silt loam soils or soils of extremely fine texture. Must be applied pre-emergence. Rainfall is required to move this chemical into the soil.[3] Naptalam acts on the seed before and during its germination. It may be absorbed by the root system after germination but does not kill by contact, so is usually not effective on established weeds.[3]

[ii] RATES — 2.2-8.9 kg a.i./ha. Granular: broadcast rate of 22.4-67.3 kg/ha.

CARRIER: Water at a rate of 22.4-44.4 kg/ha. Reduce dosage on light soils and increase it on high organic soils.[3]

[iii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Non-flammable. Shelf life is >4 to 5 years. Non-corrosive and non-explosive. Hydrolyzed in solutions of pH >9.5. Unstable at elevated temperatures.[1]

4. HANDLING PRECAUTIONS

May be detrimental to crop when applied to soil low in organic matter or clay content, or of high pH (9-12). Do not apply in temperatures >37.8°C. Do not use in wooden spray tanks. Do not graze treated areas. Avoid freezing in storage. Do not apply to emerged soybeans. Incompatible with pesticides which may cause amine transfer or replacement.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — In soil, lasts for 21-56 days.[6] Effective 3-8 weeks; completely decomposes in 6-8 weeks.[3]

Leaches rapidly in highly porous or silt loam soils. Microbial breakdown is slow. Negligible loss to volatilization.[4]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	8200 mg/kg	Acid	2
Rat	LD_{50} oral	1770 mg/kg	Sodium salt	4
Rat	90d F.T.	1000 mg/kg diet	No adverse effect	4
Dog	90d F.T.	5000 mg/kg	No effect	4
Mallard	LD_{50} oral	>4640 mg/kg		1
Rainbow trout	LC_{50} 96h	76.1 mg/L		1
Daphnia	*EC_{50} 48h*	*118.5 mg/L*		*1*

[i] TOXICITY (OTHER) — Inhalation may cause slight irritation. Limited information indicates no effect on fish or wildlife.[4] Non-toxic to skin. Non-toxic to bees.[1] Not a bacterial mutagen.[1] Non-mutagenic, non-teratogenic, no reproductive effects in rats.[4]

[ii] PHYTOTOXICITY — Bees, tomatoes, spinach and lettuce are extremely sensitive.

7. METABOLISM

[i] ANIMAL – Not identified

[ii] PLANT - Appears to break down in plants to alpha-naphthylamine and phthalic acid.[4]

8. ADDITIONAL INFORMATION

Dyanap, a mixture of Alanap and dinoseb used as pre- and post-emergence selective herbicide, provides more consistent weed control in dry soil and better annual grass control than naptalam alone.[5] Recommended on cucumbers.[5] Non-volatile chemical activated by moisture. May be tank mixed with certain other herbicides.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control.* 101 pp.
6. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
7. HSDB

1-Napthylacetic acid

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The names 1-napthylacetic acid or 1-naphthaleneacetic acid (BSI, E-ISO); acide naphtylacetique (F-ISO) are accepted in lieu of a common name.

[ii] TRADE NAME — Fruitone N (Aventis), Fruit Fix (Amvac Chemical); Celmone (Excel); Other names include Nafusaku, Phyomone, Planofix, Plucker, Primicol, Rootone, Stik, Tekkam, Tip Off, and Transplantone. *Tre Hold(Union Carbide Ltd.).*

[iii] CHEMICAL NAME — 2-(1-naphthyl) acetic acid

[iv] CAS # — 86-87-3

[v] TYPE / MODE OF ACTION — Growth regulator. Acts as a growth inhibitor at high concentrations. Stimulates root formation.

2. USE PATTERN

HERBICIDE: Growth regulator. Thins apple and pear blossoms. Controls apple and pear pre-harvest drop. Used to prevent re-sprouting of olive, cherry, apple, pear and crabapple trees. Also used to induce flowering in pineapples and to inhibit sprouting in potatoes, sweet potatoes, turnips, non-bearing citrus, and others.[2]

[i] APPLICATION — Dip basal end of cutting before placing in rooting medium. Otherwise, foliar spray is the usual application method. For blossom thinning spray apples 14-21 days after calyx period; drop, spray at the first sign of mature fruit drop. Thorough coverage is essential. More effective at higher temperatures. May be applied by air.

[ii] RATES — Rooting cuttings, 793-4000 mg/L. Blossom thinning, 5.0-50.0 mg/L. Pre-harvest drop control, 5.0-10.0 mg/L. Olives, 150 mg/L.

CARRIER: Usual carrier for rooting compounds is talc. Water is the primary carrier for other formulations.

[iii] FORMULATIONS

1. SN
2. WP
3. DU
4. Other chemical formulations available, 1-naphtaleneacetamide in Amid-Thin W; included in Rootone; Fruitone N is sodium salt (water soluble).

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Calculated: 0 m
3. Aerial application: Not identified
4. Forestry application: Not identified

3. STORAGE

Stable. Non-flammable, non-corrosive. Store in cool, dark, dry place.

4. HANDLING PRECAUTIONS

Do not spray in strong sunlight; preferably spray in late afternoon, evening or at dusk. For normal handling and application use normal spraying practices. No symptoms of poisoning. First Aid and antidotes — treat symptomatically. Do not get on skin or in eyes. Do not apply more than 6.3 kg/ha. Avoid drift. Do not mix with other pesticides. Do not spray trees for thinning purposes until 12-14 years old. Weak trees easily overthinned. Do not overlap or overspray lower branches. Do not make more than 2 applications/seasons. Do not use to thin early summer varieties of apples. Thinning effect not immediately seen since fruit will not begin falling for 7-10 days. Reduces fruit drop by 90%. Not effective for drop prevention on Anjou pears. Wear gloves.

5. ENVIRONMENTAL PERSISTENCE

Does not persist in plants.

[i] SOIL – Not expected to undergo hydrolysis in soils, may undergo direct photolysis in sunlit surface soils.[3]

[ii] AQUATIC – Not expected to undergo hydrolysis in environmental waters, may photolyze in sunlit waters.[3]

[iii] ATMOSPHERIC – May undergo direct photolysis in the atmosphere.[3]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1000-5900 mg/kg	Acid	1
Mice	LD_{50} oral	700 mg/kg	Sodium salt	1
Mallard	LD_{50} dietary 8h	>10000 mg/kg		1
Rainbow trout	LC_{50} 96h	57.0 mg/L		1
Bluegill	LC_{50} 96h	82.0 mg/L		1
Daphnia magna	*EC_{50} 48h*	*360 mg/L*		*1*

[i] TOXICITY (OTHER) — In animals, slight to moderate irritation to skin on prolonged contact. Irritating to eyes. Not toxic to bees when used as directed.

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Nearly all excreted in urine and faeces from rats within three days. [3]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. AC
3. HSDB

Nonyl phenoxy polyethoxy ethanol

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — nonyl phenoxy polyethoxy ethanol

[ii] TRADE NAME — Agral (Zeneca Agro); Enhance (Dow AgroSciences Canada Inc.); *Guardsman (Van Waters and Rogers Ltd.)*

[iii] CHEMICAL NAME — nonyl phenoxy polyethoxy ethanol

[iv] CAS # — 9016-45-9

[v] TYPE / MODE OF ACTION — Spreading agent. Non-ionic wetting and spreading agent. Improves wetting and spreading properties of all types of crop protection sprays.

2. USE PATTERN

[i] APPLICATION — Tank mixed with herbicides such as glyphosate and atrazine and applied to many different crops in zero till, minimum till, and conventional cropping systems.

[ii] RATES — 0.225-2.25 L a.i./ha in 1000L spray.[2]

CARRIER: Solution.

[iii] FORMULATIONS

1. EC
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Not identified.
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Non-corrosive, stable at least 2 years in unopened containers.[1]

4. HANDLING PRECAUTIONS

Not identified.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	4.0 g/kg		1

[i] TOXICITY (OTHER) - Not identified.

[ii] PHYTOTOXICITY - Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. FCH
2. PMRA

Octyl phenoxy polyethoxy ethanol

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — octyl phenoxy polyethoxy ethanol

[ii] TRADE NAME — Citowett (BASF Canada Inc.); Companion (Rohm and Haas Canada Inc.) Super Spreader (United Agri Products).

[iii] CHEMICAL NAME — octyl phenoxy polyethoxy ethanol

[iv] CAS # — 9036-19-5

[v] TYPE / MODE OF ACTION — Water soluble, non-ionic surfactant and adjuvant. Enhances the effectiveness of agricultural chemicals. Reduces the surface tension of the spray and increases the adherence of plant protection products to the leaf surface, preventing the product from dripping off.[1]

2. USE PATTERN

Can be mixed with metsulfuron-methyl, atrazine, bentazon, Telar(R), ethametsulfuron-methyl , pyrazon, thifensulfuron-methyl, and others.

[i] APPLICATION – Water.

[ii] RATES— Bentazon, pyrazon, atrazine, 0.63-1.25 L a.i./1000 L spray solution. Thifensulfuron-methyl, Telar(R), 0.5 L a.i./1000 L spray solution. Metsulfuron-methyl, ethametsulfuron-methyl, 1.0 L a.i./1000 L spray solution.[1]

CARRIER: Not identified.

[iii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

May be stored for a minimum of two years at any temperature without loss of activity.[1] Store in original, tightly closed container; in cool, dry, locked well-ventilated area without floor drain.[1] Do not ship or store near food, feed, seed, fertilizers and pesticides.[1]

4. HANDLING PRECAUTIONS

Keep out of reach of children. Do not take internally; avoid inhalation of vapour, dust or spray mist and contact with eyes, skin and clothing.[1] Wash thoroughly after handling, before eating, drinking or smoking. If clothing becomes contaminated, remove and wash separately from household laundry before re-use.[1] Do not contaminate domestic or irrigation water, lakes, sreams and ponds by the cleaning of equipment or the diposal of wastes; clean spray equipment thoroughly after use.[1] Do no graze the treated immature crops or cut for hay.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

[i] TOXICITY (OTHER) – Not identified.

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PMRA

Oxamyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — oxamyl (BSI, E-ISO, F-ISO, ANSI, ESA); oxamil (JMAF)

[ii] TRADE NAME — Vydate (DuPont Canada Inc.)

[iii] CHEMICAL NAME — *N,N*-dimethyl-2-methycarbomoyloxyimino-2-(methylthio)acetamide

[iv] CAS # — 23135-22-0

[v] TYPE / MODE OF ACTION — A carbonate compound used as a contact and systemic insecticide, nematacide, and acaricide.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

For control of black current gall mites [5], flea beetles, leaf miners, nematodes, scales, leafhoppers, thrips, aphids, and others. Used on many field crops, fruit, ornamentals, potatoes and other vegetables. Controls the Raspberry Root Lesion Nematode in raspberries. Wireworms are not controlled.

[i] APPLICATION — May be applied as a foliar spray, soil drench, or slow-release tablet (placed in soil at roots of plant). The slow-release tablet has been shown to be equally or more effective than the other two methods.[4] Soil applications utilize the systemic properties of oxamyl. May also be used as a root, corn, or bulb dip.

[ii] RATES — 300-720 g a.i./300-1000 L H_2O.

CARRIER: Solution.

[iii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: (1.4) 1.0 m
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Decompostion is increased by aeration, sunlight, alkalinity and higher temperatures.[8]

4. HANDLING PRECAUTIONS

Incompatible with alkaline materials.[1] Highly flammable: will be easily ignited by heat, sparks or flames.[8] Wear chemical protective clothing [8]

5. ENVIRONMENTAL PERSISTENCE

This chemical is considered to have moderate residual effects.

[i] SOIL — Less than 5% oxamyl was found remaining after 1 day in water-saturated anaerobic sub-soils. Conversion rates in aerobic soil layers above the water table were much slower, with half-lives of 21-415 days, depending on the soil type. Oxamyl decomposes in soil to the non-toxic oxime, which has been shown to leach (along with the parent compound) in field studies.[3] Generally of low persistence in the soil with reported field-lives of 4 to 20 days; decomposition by aerobic and anaerobic bacteria.[7]

[ii] AQUATIC — Stable. The aqueous solution decomposes slowly. Half-life of 1 to 2 days in river water.[7]

[iii] ATMOSPHERIC – If released to the atmosphere, oxamyl will exist almost entirely in the vapor phase. Vapor-phase oxamyl is degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of about 15 hours.[8]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identifed.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	5.4 mg/kg		1
Rat	LC$_{50}$ inhalation 1h	0.17 mg/L air	Males; atomized spray	1
Rat	LC$_{50}$ inhalation 1h	0.12 mg/L air	Females; atomized spray	1
Rat	NOEL 2y	50.0 mg a.i./kg diet		1
Rabbit	LD$_{50}$ dermal	5027 mg a.i./kg	Males	1
Dog	NOEL 2y	100 mg/kg diet		1
Human	ADI	0.03 mg/kg		6
Human	PADI	0.025 mg/kg		3
Quail	LD$_{50}$ oral	4.18 mg a.i./kg		1
Bobwhite quail	LC$_{50}$ dietary 8d	340 ppm		1
Mallard	LC$_{50}$ dietary 8d	766 ppm		1
Bluegill	LC$_{50}$ 96h	5.6 mg/L		3
Rainbow trout	LC$_{50}$ 96h	4.2 mg/L		3
Goldfish	LC$_{50}$ 96h	27.5 mg/L		1
Daphnia magna	*LC$_{50}$ 48h*	*5.7 mg/L*		*3*
Daphnia magna	*LC$_{50}$ 96h*	*5.7 mg/L*		*3*

[i] TOXICITY (OTHER) — Toxic to bees and birds.[7] Birds and wildlife feeding in the treated area may be killed. Toxic to fish. Non-oncogenic in mice at 25.0 mg/kg; non-teratogenic in rabbits at 4.0 mg/kg; non-mutagenic[1]; non-carcinogenic[7].

[ii] PHYTOTOXICITY — Generally non-phytotoxic when used as directed.[2] Some strawberry varieties will be injured.[2] Phytotoxicity is greater in tomatoes receiving slow-release tablets than with other methods and inceases as the number of tablets per plant increases.[4]

7. METABOLISM

[i] ANIMAL – When administered to rats, most of the dose was rapidly eliminated in the urine and faeces as metabolites; oxamyl is generally excreted rapidly and does not accumulate in mammal tissue.[7]

[ii] PLANT – Metabolized rapidly by plants with a residual period of approximately 1 to 2 weeks.[7]

8. ADDITIONAL INFORMATION

There is no significant uptake of oxamyl residues in rotation crops.[6]

9. REFERENCES

1. PM
2. AC
3. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
4. Ghidiu, G.M., and R.D. Oetting (1987) Oxamyl slow-release tablets, foliar sprays, and transplant drench applications for Colorado potato beetle (Coleoptera: Chrysomelidae) control on tomato. *J. Econ. Entomol.* 80: 876-879.
5. Nielsen, S.L. (1987) Chemicals-tested in the laboratory for the control of black currant gall mite *(Cecidophyopsis ribis* Westw.*) Tidsskr. Planteavl.* Vol. 9 pp 89-93.
6. Pesticide Residues in Food-1986. Evaluations 1986 Part I., Residues., FAO Plant Prod. Prot. Pap. 78: 249-251.
7. PP
8. HSDB

Oxycarboxin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — oxycarboxin (BSI, E-ISO, ANSI, JMAF); oxycarboxine (F-ISO)

[ii] TRADE NAME — HRC, Plantavax (Uniroyal Ltd.)

[iii] CHEMICAL NAME — 5,6-dihydro-2-methyl-1,4-oxathi-ine-3-carboxanilide 4,4-dioxide

[iv] CAS # — 5259-88-1

[v] TYPE / MODE OF ACTION — An organic compound used as a fungicide.

[vi] NOTICE — Registration of oxycarboxin expired December 31, 2002 due to late renewal submission. **Active is currently being assessed and is expected to be renewed.**

2. USE PATTERN

This systemic fungicide is used for the treatment of rust diseases of cereals, ornamentals, and vegetables. Also used on carnations and geraniums.[2]

[i] APPLICATION — May be used in greenhouses with regular watering and fertilizing, applied at 2-week intervals. Also used as a spray at 2-week intervals. Use at a dosage of 20 ppm.

[ii] RATES — 62.5 mL/m^3.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable, except under highly acidic or highly alkaline conditions.[3]

4. HANDLING PRECAUTIONS

Not to be mixed with insecticides and acaricides, as plant injury may occur.[1] Do not inhale dust or spray mist; avoid contact with skin and mucous membranes.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – If released to soil, oxycarboxin may biodegrade under aerobic conditions. Oxycarboxin is highly mobile in soil. Volatilization from either moist or dry soil to the atmosphere is expected to be slow.[3]

[ii] AQUATIC – If released to water, volatilization of oxycarboxin to the atmosphere may be very slow. The estimated half-life for volatilization from a model river is > 1000 days.[3] Adsorption to sediment and suspended organic matter is not expected to be a significant fate process.[3]

[iii] ATMOSPHERIC – If released to the atmosphere, oxycarboxin may undergo oxidation by a gas-phase reaction with photochemically produced hydroxyl radicals with an estimated half-life of 1.7 hours. It may also undergo atmospheric removal by wet deposition processes.[3]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	2000 mg/kg		1
Rat	NOEL 2y	3000 mg/kg		1
Rabbit	LD_{50} dermal	>16000 mg/kg		1
Dog	NOEL 2y	3000 mg/kg		1
Bobwhite quail	LC_{50} 8d	>10,000 ppm		1
Mallard	LC_{50} 8d	>4640 ppm		1
Bluegill sunfish	LC_{50} 96h	28.1 mg/L		1
Rainbow trout	LC_{50} 96h	19.9 mg/L		1
Daphnia	*EC_{50} 48h*	*69.1 mg/L*		*1*

[i] TOXICITY (OTHER) — Causes eye damage.[2] Moderate acute oral toxicities in mammals.[3]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - This chemical is absorbed by the roots of plants and acts systemically.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. AC
3. HSDB

Oxydemeton-methyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — oxydemeton-methyl (BSI, E-ISO, F-ISO); oxydemetonmethyl (ESA); oxydemeton-methyl (USSR)

[ii] TRADE NAME — Metasystox-R (Bayer AG (Germany)); Metasystemox, Dutox, Isotox (Chemagro (US))

[iii] CHEMICAL NAME — *S*-2-ethylsulphinylethyl *O,O*-dimethyl phosphorothioate

[iv] CAS # — 301-12-2

[v] TYPE / MODE OF ACTION — A systemic and contact organophosphorus insecticide and acaricide of short persistence; alkythioether dimethyl organophosphate ester is structurally analogous to demeton (the diethyl ester).

2. USE PATTERN

Selective systemic and contact insecticide. Acaricide for control of sucking insects and mites. Used on food/feed crops, ornamentals, tobacco, and woodlands.

[i] APPLICATION — Apply to foliage as spray, to roots as a soil drench. Capable of being translocated into sap stream giving residual effectiveness. Aerial application is possible.

[ii] RATES — 300-564 g a.i./ha. 240-900 g a.i./100-1000 L.

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Calculated: 0 m
3. Aerial application: Calculated: 0 m (**for tobacco use only**)
4. Forestry application: Calculated: 0 m

3. STORAGE

Subject to hydrolysis; rate is fairly rapid in alkaline media. Oxidizes to sulfone. Decomposes at elevated temperatures.

4. HANDLING PRECAUTIONS

Do not handle treated ornamentals until spray has dried. Do not combine with alkaline compounds, Euparen, or Morestan.

5. ENVIRONMENTAL PERSISTENCE

Short persistence. Degraded by *Pseudomonas putida* by thioester bond cleavage to form three major compounds. *Nocardia* spp. Converts oxydemeton-methyl to three different metabolites by oxidation, ß elimination, and hydrolysis.[4]

[i] SOIL – Degradation in different soils is extremely rapid.

[ii] AQUATIC – If released in water, oxydemeton-methyl will slowly hydrolyze. Its half-life at pH 6 and 20°C is about 33 days and would be shorter at higher temperatures and in more alkaline water. It is not expected to volatilize, adsorb to sediment, or bioconcentrate in aquatic organisms.[5]

[iii] ATMOSPHERIC – If released into the atmosphere during spraying operations, oxydemeton-methyl will exist as an aerosol and be removed by gravitational settling and may be oxidized to the sulfone in the drifting spray. Vapor-phase oxydemeton-methyl will react with photochemically-produced hydroxyl radicals, resulting in an estimated half-life of 3.6 hours.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	30.0-75.0 mg/kg		2
Rat	LD_{50} dermal	130 mg/kg		1
Rat	NOEL 2y	1.0 mg/kg diet		1
Dog	NOEL 1y	0.05 mg/kg b.w.		
Human	ADI	0.005 mg/kg		3
Mallard	LC_{50} 5d	2003 mg/kg diet		1
Pheasant	LD_{50}	42.4 mg/kg	Young pheasants	
Chukar	LD_{50}	113 mg/kg		
Bobwhite quail	LD_{50}	34.0-37.0 mg/kg		1
Pigeon	LD_{50}	14.9 mg/kg		
House sparrow	LD_{50}	70.8 mg/kg		
Rainbow trout	LC_{50} 96h	17.0 mg/L		1
Bluegill	LC_{50} 96h	1.9 mg/L		1
Daphnia	*EC_{50} 48h*	*0.19 mg/L*		*1*
Stonefly	LC_{50} 24h	0.960 mg/L		
Gammarus lacustris	*LC_{50} 24h*	*0.750 mg/L*		

[i] TOXICITY (OTHER) — Toxic to fish, wildlife, and bees. No delayed neurotoxicity in hens. No potentiation of acute toxicity in other organophosphorus or carbamate insecticides. Mild skin and eye irritant.[1] Not a primary embryotoxin, not a mutagen.[1] Non-teratogenic in rabbit, non-mutagenic in mice, and does not interfere with reproduction in rats.

[ii] PHYTOTOXICITY — Some injury to certain ornamentals has been reported, especially in combination with other pesticides.

7. METABOLISM

By analogy with demeton, metabolism would result in oxidation of thioether to sulphoxide and sulphone. Thioether is most active *in vitro* anti-ChE agent.

[i] ANIMAL – Elimination is very quick; almost 99% is excreted within 48 hours in the urine.[1]

[ii] PLANT – Main metabolic reactions are hydrolysis and subsequent dimerisation, as well as the formulation of conjugates.[1]

8. ADDITIONAL INFORMATION

Selective with fast knockdown effect. Range of action similar to demeton-S-methyl, of which it is a metabolite.

9. REFERENCES

1. PM
2. FCH
3. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO meeting on pesticide residues. II. Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews*, 63: 1-44.
4. Ziegler, W, G. Englehardt, P.R. Wallnoefer, L. Oehlmann and K. Wagner (1980) Degradation of demeton-S-methyl sulfoxide (Metasystox R) by soil micro-organisms. *J. Agric. Food Chem.* 28: 1102-1106.
5. HSDB

Oxyfluorfen

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — oxyfluorfen (BSI, E-ISO, ANSI, WSSA); oxyfluorfene (F-ISO)

[ii] TRADE NAME — *Goal (Rohm and Haas Company)*

[iii] CHEMICAL NAME — 2-chlora-a,a,a-trifluoro-*p*-tolyl 3-ethoxy-4-nitrophenyl ether

[iv] CAS # — 42874-03-3

[v] TYPE / MODE OF ACTION — Diphenyl compound used as a selective pre-and post-emergence herbicide. Kills weeds as they come into contact with the material during emergence.[2] Absorbed by roots and foliage, and damages shoots.

[vi] NOTICE — Currently, **only the technical is registered**. No end use products are registered for use in Canada.

2. USE PATTERN

Used on dry bulb onions.

[i] APPLICATION — Apply by ground spray when leaves are in the 2-4 leaf stage and actively growing, or when the onions have two fully developed true leaves. More than one application may be necessary to control late germinating weeds. Do not apply within 56 days of harvest.

[ii] RATES — 120 g a.i./ha, or 625 mL of Goal in a minimum of 500 L water/ha.

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

2. Ground application:	Calculated: 0 m
3. Air blast application:	Not identified.
4. Aerial application:	Not identified.
5. Forestry application:	Not identified.

3. STORAGE

The EC formulation is combustible. Do not store at high temperatures (>50°C), and keep from freezing. Non-corrosive. No significant hydrolysis in 28 days at pH 5-9 (25°C). Decomposed rapidly by ultraviolet irradiation.[1]

4. HANDLING PRECAUTIONS

Keep out of reach of children. Wear goggles or face shield, chemical resistant gloves, long trousers, long sleeved shirt, or jacket of tightly woven material along with boots high enough to cover ankles during mixing, loading, cleanup and repair activities. Wash hands and exposed skin with soap and water thoroughly before eating, drinking, smoking or using the toilet. Avoid breathing vapour or spray mist or contact with clothings.[6]

5. ENVIRONMENTAL PERSISTENCE

Residues are expected to be persistent and to accumulate, to some degree, in biota. Photodegradable in water but not in soils.

[i] SOIL — Residues are not degraded by hydrolysis, photolysis, or microbial activities. Very strong absorption on a variety of soils. It has a low vapour pressure but measurable concentrations have been found in the air above treated fields, therefore this may be a significant route of dissipation. The half-life of oxyfluorfen in soils ranges from 79-120 days at proposed application rates. Because of the high adsorption to soils and low solubility in water, it is extremely resistent to leaching. It may, however, accumulate in increased sediment concentrations in wetlands, thus endangering marsh plants. High adsorption and apparently minimal desorption suggest low mobility in soil. The 50% decline time (DT_{50}) ranges from 10 months in clay loam soil to 20 months in sandy loam soil and is therefore quite persistent in lab

aerobic soil studies. Residues may be detected in mainly the upper 7.5 cm of the soil at 12 to 18 months post-treatment. Leaching potential is limited.[4]

[ii] AQUATIC — There is a very significant photolytic degradation in water, with a half-life of about 12 hours.

[iii] ATMOSPHERIC - Not identified.

[iv] PHYTODEGRADATION — Exposure of consumers to residues in food should be minimal, because residues of oxyfluorfen and its metabolites on the harvested bulb are expected to be less than 0.01 mg/L.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg		1
Rat	NOEL	40.0 mg/kg diet		1
Rat	2y F.T.	2.0 mg a.i./kg	NOAEL	
Rat	1y F.T.	650 mg a.i./kg	Pathological effects	
Rabbit	LD_{50} dermal	>10000 mg/kg	Mildly irritating to rabbit skin and eyes	1
Dog	LD_{50} oral	>5000 mg/kg		3
Dog	NOEL	100 mg/kg diet		3
Human	ADI	0.003 mg/kg		1
Bobwhite quail	LC_{50} dietary 8d	>5000 mg/kg		1
Bobwhite quail		LD_{50} oral	>2150 mg/kg	1
Mallard	LC_{50} dietary 8d	>5000 mg/kg		1
Bluegill	LC_{50} 96h	0.2 mg/L		1
Trout	LC_{50} 96h	0.41 mg/L		1
Grass shrimp	LC_{50} 96h	0.032 mg a.i./L		
Freshwater clam	LC_{50} 96h	9.6 mg a.i./L		
Eastern oyster	LC_{50} 48h	>0.032 mg a.i./L		
Daphnia	*EC_{50} 48h*	*1.5 mg a.i./L*		*1*

[i] TOXICITY (OTHER) — Chronic exposure in dogs causes bile pigmented hepatocytes, thyroditis, C-cell hyperplasia, etc. Toxic to fish and upland gamebirds but not to waterfowl.[3] Oxyflourfen is toxic to aquatic invertebrates and wildlife. Non-toxic to bees at 0.025 mg A.I./bee.[1] Skin irritant, eye irritant, skin sensitizer.[6] Appears non-teratogenic, but studies are inadequate. Technical material appears to be mutagenic but purified material is not. It does not appear likely that oxyfluorfen will cause reproductive effects in humans at normal levels of exposure.[5] Non-carcinogenic.[5]

[ii] PHYTOTOXICITY — Phytotoxic to the green alga *Scenedesmus acutus* and possibly other aquatic macrophytes. Soya beans and cotton may be injured by contact with oxyfluorfen.[1]

7. METABOLISM

[i] ANIMAL - Excretion is rapid and mainly via the faeces. Six faecal metabolites were isolated.

[ii] PLANT - Not readily metabolized in plants.[1] Since it is not readily taken up by roots, residues in plants are generally very low.[5]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. AC
3. HH
4. Rohm and Haas Canada Inc., data submitted to Agriculture Canada, 1990.
5. PP
6. PMRA. Goal 2XL. Roahm and Haas Canada.Inc.

Paraffin base mineral oil

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — paraffin base mineral oil 83%, surfactant blend 17%

[ii] TRADE NAME — Assist Oil Concentrate (BASF Canada Inc.); Kornoil (Shell Canada); Sunoco.

[iii] CHEMICAL NAME — paraffin base mineral oil 83%, surfactant blend 17%

[iv] CAS # - Not identified.

[iv] TYPE / MODE OF ACTION — Adjuvant and surfactant to be used in conjunction with herbicides. Prevents evaporation and helps the herbicide to remain in contact with target weeds.

2. USE PATTERN

For use with post-emergent herbicide sprays of Poast, Basagran, Laddok, and atrazine sprays.

[i] APPLICATION — Amount of Assist used depends on the herbicide it is used with and the type of weed to be controlled. For example, when used with:

(1) Poast for wild oats, volunteer cereals, and annual grasses, use 50-200 L water/ha with 0.5-4.0 L Assist concentrate.

(2) Basagran, apply to emerged broadleaf weeds using 50-400 L water/ha with 0.125-4.0 L of Assist concentrate.

(3) Basagran & Laddok (corn, grain, silage, sweet, and seed), apply when weeds are 0.5 to 30 cm in height according to the directions on the Laddok and Basagran labels.

(4) Atrazine (corn, grain, silage, sweet, and seed), apply to emerged broadleaf weeds and grasses before they are 4 cm in height and before 24 days from date of planting. Do not apply after corn is 15 cm in height for application with atrazine.

[ii] RATES — Application rates are given in the above examples; maximum for ground spray is 2.0 L/ha in 100-400 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

2. Ground application: Not identified.
3. Air blast application: Not identified.
4. Aerial application: Not identified.
5. Forestry application: Not identified.

3. STORAGE

Store in the original, tightly-closed container, and do not allow water to be introduced to this container. Do not store near food, feed, seed, fertilizers, or pesticides. Store in a cool, dry, locked, well-ventilated area without floor drain.

4. HANDLING PRECAUTIONS

Avoid inhalation of vapour and dust and avoid contact with eyes, skin, or clothing. Clean spray equipment thoroughly after use. Do not contaminate domestic or irrigation water, lakes, streams, or ponds by the cleaning of equipment or waste disposal. Do not add hormone-type weed killers such as 2,4-D, 2,4-DB, MCPA, dicamba, Kil-Mor, or any other herbicides to combinations of oil-water emulsions of atrazine for use in corn. Wear appropriate personal protective clothing to prevent skin contact including: goggles or face shield.[1] Contaminated protective clothing should be segregated in such a manner so that there is no direct personal contact by personnel who handle, dispose, or clean the clothing.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

[i] TOXICITY (OTHER) – Not identified.

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Absorbed to a limited extent from the intestinal tract.[1] Mineral oil mists derived from highly refined oils and several formulated products appear to have a low acute and low sub-acute toxicity in animals. Single and short term repeated exposures (up to six months) to relative high concentrations (well in excess of 100 mg/cu m) have resulted in lung inflammatory reaction, lipoid granuloma formation, and lipoid pneumonia.[1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9.REFERENCES

1. HSDB

Paraquat

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — paraquat (BSI, E-ISO, F-ISO, ANSI, WSSA, JMAF); exception (FRG)

[ii] TRADE NAME — Gramoxone, Terraklene, Reglone, Tota-Col, Sweep No-till (Zeneca Agro)

[iii] CHEMICAL NAME — 1,1'-dimethyl-4,4'-bipyridinium ion: as dichloride or dimethyl sulphate salt.

[iv] CAS # — 4685-14-7

[v] TYPE / MODE OF ACTION — Pyridine compound used as a non-selective post-emergence contact herbicide for control of herbaceous plants. During photosynthesis, paraquat dichloride causes the formation of superoxide which damages cell membranes and cytoplasm.[1]

2. USE PATTERN

For weed control during establishment of grass seed crops. General contact herbicide for non-crop usages, on fallowland as a herbicide for orchard weed control, as a pre-emergence herbicide and as a direct post-emergence herbicide. Registered as a crop desiccant and defoliant on potatoes. No-tillage corn use and harvest aid of soybean is also registered.

[i] APPLICATION — Ground or air foliar spray.

[ii] RATES — Vegetable and field crops, 0.55 kg a.i./ha in 300-1100 L water. Potatoes, 0.55-0.85 kg a.i./ha in 300-550 L water. Fruit crops, 1.1 kg a.i./ha in 1100 L water.[1]

X-77 surfactant or equivalent is recommended for use with paraquat. Other non-ionic and cationic surfactants are compatible with paraquat. When applied in liquid fertilizers or nitrogen solutions, 455-910 L of X-77 is recommended.

CARRIER: Water, solution.

[iii] FORMULATIONS

1. SN
2. SG
3. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 45-55 m (for product containing paraquat (132g/L) and diquat (66g/L))
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Under normal storage conditions in original containers, shelf life is indefinitely long. The dry chemical is somewhat sensitive to UV light. The product is stable to heat beyond the range of ordinary ambient temperatures. Stable except in alkaline conditions. Not normally corrosive to spray equipment. Unformulated products corrosive to metal.

4. HANDLING PRECAUTIONS

Do not put in food or drink containers. Keep out of reach of children. Do not allow animals to graze treated area. Prevent skin or eye contact by wearing rubber gloves and goggles or eye shield when handling.[9] Avoid breathing spray mist; can damage lungs.[9] Do not use on pure sand or muck soils. Do not use with anionic surfactants.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Highly persistent in soil with reported half-lives of greater than 1000 days. Not highly mobile.[3] Clay and organic matter strongly absorb paraquat and limit its bioavailability. Ultraviolet light, sunlight and soil microorganisms can degrade paraquat to products that are less toxic than the parent compound.[5]

[ii] AQUATIC — Expected to bind strongly to particulates and sediment. Removed from water in 8-12 days.[3] Aquatic weeds may bioaccumulate this compound.[5] Residues not detectable 16 days after an application of 0.5 mg/kg.[10] Absorption by aquatic plants is considerable.[7]

[iii] ATMOSPHERIC - If released to air, paraquat will exist predominantly in the particulate phase. Particulate paraquat may be removed from the atmosphere both by dry and wet deposition.[3]

[iv] PHYTODEGRADATION — Photochemical breakdown occurs to paraquat on plant surfaces.[1]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	110-150 mg/kg		1
Rat	NOEL 2y	170 mg/kg diet		1
Mouse	LD$_{50}$ oral	104 mg/kg		1
Guinea pig	LD$_{50}$ oral	22.0-42.0 mg/kg		1
Rabbit	LD$_{50}$ dermal	236-325 mg/kg		5
Dog	LD$_{50}$ oral	25.0-50.0 mg/kg		1
Dog	NOEL 2y	34.0 mg/kg diet		1
Sheep	LD$_{50}$ oral	50.0-70.0 mg/kg		1
Chicken	LD$_{50}$ oral	262 mg/kg		3
Hen	LD$_{50}$ oral	262-380 mg/kg		1
Bobwhite quail	LC$_{50}$ 5d	981 mg/kg		8
Japanese quail	LC$_{50}$ 5d	970 mg/kg		8
Pheasant	LC$_{50}$ 5d	1468 mg/kg		8
Mallard	LC$_{50}$ 5d	4048 mg/kg		8
American kestrel	Ingestion	60.0 mg/kg/d	44% mortality in 4 days. Decrease in growth rates. Localized focal necrosis of the liver.	8
Rainbow trout	LC$_{50}$ 96h	32.0 mg/L		1
Brown trout	LC$_{50}$ 96h	2.5-13.0 mg/L		1
Bluegill	LC$_{50}$ 96h	13.0 mg/L		3
Channel catfish	LC$_{50}$ 96h	>100 mg/L	Static bioassay	3
Harlequin fish	LC$_{50}$ 24h	45.0 mg/L		4
Crayfish	LC$_{50}$ 48h	5.2 mg/L		4
Gammarus fasciatus	LC$_{50}$ 96h	11.0 mg/L		3
Daphnia pulex	LC$_{50}$	1.2-4.0 mg/L		5
Freshwater copepods	LC$_{50}$ 24h	10.0 mg/L		10
Freshwater copepods	LC$_{50}$ 48h	5.3 mg/L		10

[i] TOXICITY (OTHER) — Irritant to eyes; can cause temporary damage to nails and, if inhaled, may cause nose bleeding. Absorbed through skin only after prolonged exposure; shorter exposures can cause irritation and delay in wound healing.[1] As paraquat has no appreciable vapour pressure, there is no hazard from inhalation. Prolonged, direct contact with the spray mist may cause oral and nasal irritation and should be avoided. Low fish and wildlife toxicity. Toxic to neonatal animals, resulting in extensive histopathological damage of the lungs. Highly embryotoxic to birds, both topically and by injection into eggs.[8] Treatment of *R. pipiens* at the early gastrula stage with 0.5 mg/L paraquat resulted in the survival of only 6.3% /day.[7] It is reported to produce retardation of growth, significant levels of tail malformations, and poor head development.[6] Not toxic to bees. Tree bark, once free of chlorophyll, is not injured by paraquat. Slightly to moderately toxic to many species of aquatic life.[5] Unlikely to cause reproductive effects in humans at expected exposure levels.[5] Studies of paraquat using rabbits and mice have shown no teratogenic effects.[5]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL — In rats, 76-90% and 11-20% of a dose was excreted in the faeces and urine, respectively, following oral administration.[1] May concentrate in lung tissue where it can be transformed into highly reactive and potentially toxic forms.[5]

[ii] PLANT — No metabolic breakdown in tomato, broad bean and maize. In sunlight, some photochemical breakdown occurs to N-methyl isonicotinic acid and methylamine (very low mammalian toxicities).

8. ADDITIONAL INFORMATION

Rapid action. Used in range improvement programs and on aquatic weeds. Compatible with many other residual herbicides. Rainfall after application has little bearing on effectiveness. Weeds should be 2.5-15 cm high for best results.

9. REFERENCES

1. PM
2. PMRA
3. HSDB
4. CESARS
5. PP
6. Dial, N.A. and C.A. Bauer (1984) Teratogenic and lethal effects of paraquat on developing frog embryos. *Bull. Environ. Contam. Toxicol.*, 33: 592-597.
7. Dial, N.A. and C.A. Bauer Dial (1987) Lethal effects of diquat and paraquat on developing frog embryos and 15 day old tadpoles, *Rana pipiens*. *Bull. Environ. Contam. Toxicol.*, 38: 1006-1011.
8. Hoffman, D.J., J.C. Franson, O.H. Pattee, C.M. Bunck and H.C. Murray (1987) Toxicity of Paraquat in Nesting Birds: Effects on plasma and tissue Biochemistry in American kestrals. *Arch. Environ. Contam. Toxicol.* 16: 177-183.
9. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control.* 101 pp.
10. Naqvi, S.M., T.S. Leung and N.Z. Naqvi (1980) Toxicities of paraquat and diquat herbicides to freshwater copepods (*Diaptomus* sp. and *Eucyclops* sp.). *Bull. Environ. Contam. Toxicol.* 25: 918-920.
11. Wat, J.M. *et al.* (1971) Some ecological effects of the use of paraquat for the control of weeds in small lakes. *J. Appl. Ecol.* 8: 509-532.

Parathion

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — parathion (BSI, E-ISO, F-ISO, ESA, JMAF)

[ii] TRADE NAME — Parathion, *Clean Crop* (United Agri Products); Plant-Fume (Plant Products Co. Ltd.); *Aqua Parathion (Rhone Poulenc Canada Inc.); Guardsman (Van Waters and Rogers Ltd.)..*

[iii] CHEMICAL NAME — *O,O*-diethyl *O*-(4-nitrophenyl)phosphorothioate

[iv] CAS # — 56-38-2

[v] TYPE / MODE OF ACTION — Organophosphorus insecticide and acaricide. Non-systemic with contact and stomach action. Cholinesterase inhibitor.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Used for control of chewing and sucking insects on ornamentals, field and vegetable crops, fruit crops, and vine crops. Compatible with most pesticides, excluding alkaline materials.

[i] APPLICATION — Apply to foliage when pests are first noticed.

[ii] RATES — Tree fruit, 0.26-0.5 kg a.i./1000 L water. Vegetable crops, 0.22-0.57 kg a.i./ha. Corn, 0.57-0.70 kg a.i./ha. [2]

CARRIER: Water, solvent.

[iii] FORMULATIONS

1. EC
2. WP
3. GR

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Calculated: 1(1) m
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Do not store above 25°C. Product must be kept under lock and key and away from food/feed.[2] Hydrolysed very slowly in acidic media, more rapidly in alkaline media.[1] All parathion containers shall be protected from corrosion, mechanical damage, and sources of ignition. Outdoor storage facilities shall be located at least 20 feet from any dwellings, or a populated area and shall be equipped with a sprinkler system, where feasible.[3]

4. HANDLING PRECAUTIONS

Do not apply more than twice a season to any crop.[2] Avoid applying in extremely hot weather. Fatal poisoning can result from ingestion, skin absorption, or inhalation. Incompatible with alkaline materials.[1] Wear chemical protective clothing including: impervious clothing, gloves, face shields (eight inch minimum), and other appropriate protective gear necessary to prevent repeated, or prolonged skin contact with parathion.[3] Protective clothes should be removed and a shower taken before returning to street clothes. If clothing becomes contaminated with parathion, it should be immediately removed and a shower taken without delay. Smoking or eating should not be permitted when handling parathion until all outer working clothing is removed and the hands and face are washed.[3] Contact lenses should not be worn when working with this chemical.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Binds tightly to soil and remains for several weeks.[3] Biological and chemical hydrolysis are the major fate processes. Photolysis may occur at the soil surface. Low mobility.[1]

[ii] AQUATIC — Removed in approximately one week through adsorption to sediment and particulate matter.[3] Bioconcentration is expected to be low to moderate. If released into water, parathion is expected to adsorb to suspended solids and sediment in the water column based upon sediment K_{oc} values ranging from 3,086 to 38,000. Parathion biodegrades in acclimated natural waters within several weeks. Volatilization from water surfaces is not expected to be an important fate process.[3]

[iii] ATMOSPHERIC – If released to air parathion will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase parathion will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 4.2 hours. Particulate-phase parathion will be removed from the atmosphere by wet and dry deposition. Parathion absorbs radiation with wavelengths shorter than 320 nm, suggesting a potential for direct photolysis.[3]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	c. 2.0 mg/L		1
Rat	LD_{50} inhalation 4h	0.05 mg/L	Males/females	1
Rat	NOEL 2y	2.0 mg/kg diet		1
Mouse	LD_{50} oral	c. 12.0 mg/kg		1
Dog	NOEL 1y	<0.01 mg/kg/d		1
Mallard	LD_{50} oral	2.13 mg/kg		3
Pheasant	LD_{50} oral	12.4 mg/kg		3
Chukar	LD_{50} oral	24.0 mg/kg		3
Rainbow trout	LC_{50} 96h	1.5 mg/L		1
Bluegill	LC_{50} 96h	0.4 mg/L		3
Largemouth bass	LC_{50} 96h	0.62 mg/L		3
Golden orfe	LC_{50} 96h	0.57 mg/L		1
Fathead minnow	LC_{50} 96h	2.35 mg/L		3
Crayfish	LC_{50} 96h	<0.25 mg/L		3
Stonefly	LC_{50} 96h	0.0054 mg/L		3
Gammarus fasciatus	*LC_{50} 96h*	*0.0034 mg/L*		*3*
Daphnia	*EC_{50} 48h*	*0.0025 mg/L*		*1*

[i] TOXICITY (OTHER) – Toxic to bees.[1] Effects on birds are minimal[3]

[ii] PHYTOTOXICITY – It is non-phytotoxic except to some ornamentals and, under certain weather conditions, to pears and some apple varieties.[3]

7. METABOLISM

[i] ANIMAL – Five days following ip admin to rats, the urinary excretion of parathion was greater than 80%.[3]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. PMRA
3. HSDB

Pebulate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — pebulate (BSI, E-ISO, F-ISO, WSSA, JMAF)

[ii] TRADE NAME — Tillam (Stauffer Chemical Co.)

[iii] CHEMICAL NAME — *S*-propyl butyl(ethyl)thiocarbamate

[iv] CAS # — 1114-71-2

[v] TYPE / MODE OF ACTION — Tillam is a selective thiocarbamate herbicide applied pre-plant or post-plant. Soil incorporated.

[vi] NOTICE — Currently, **only the technical is registered.** No end-use products are registered for use in Canada. **The active is under re-evaluation.**

2. USE PATTERN

Controls both grass and broadleaf weeds in tomatoes, sugarbeets, and tobacco.

[i] APPLICATION — Prepare seed bed and apply pre-plant. Incorporate 5-10 cm immediately after application. Can be seeded immediately after treatment.

[ii] RATES — 4.4-8.8 kg a.i./ha in 225-1123 L water.[3]

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

2. Ground application: Calculated: 0 m
3. Air blast application: Not identified.
4. Aerial application: Not identified.
5. Forestry application: Not identified.

3. STORAGE

Non-corrosive. Stable up to 200ºC.[1] Apparently indefinite storage life under normal ambient conditions.[4]

4. HANDLING PRECAUTIONS

No known incompatibilities.[4] Wear long-sleeved shirts, long pants, shoes, socks, protective eyewear and chemical resistant gloves for personal protection.[5]

5. ENVIRONMENTAL PERSISTENCE

Activity should last 6-8 weeks.[3]

[i] SOIL — At recommended rates, does not persist in soil and does not leave phytotoxic residues. Half-life in moist loam soil at 21-27°C is about 2 weeks.[4] Adsorbed on to dry soil but can be removed by leaching.[4] Loss from the soil is primarily due to microbial decomposition.[4] Leaches fairly readily.[4]

[ii] AQUATIC – If released to water, pebulate's volatilization will not be rapid but may possibly be important. Bioconcentration and adsorption to sediment are not expected to be important fate processes.[6]

[iii] ATMOSPHERIC – If released to the atmosphere, pebulate will exist primarily in the vapor phase. In the vapor phase, it will degrade in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half-life of 13.5 hours. Photodegradation of pebulate by photolysis with ultraviolet light may prove as an important means of removal of pebulate from the environment. Physical removal from air can occur through wet and dry deposition.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50}	921-1120 mg/kg		4
Rat	90d F.T.	16.0 mg/kg/d	No effect	4
Mouse	LD_{50}	1652 mg/kg		4
Rabbit	LD_{50} dermal	4640 mg/kg		2
Dog	90d F.T.	20.0 mg/kg/d	No effect	4
Bobwhite quail	LC_{50} 7d F.T.	8400 mg/L	Technical pebulate	4
Bobwhite quail	LC_{50} 7d F.T.	9500 mg/L	Pebulate 6E	4
Rainbow trout	LC_{50} 96h	c. 7.4 mg/L		1
Bluegill sunfish	LC_{50} 96h	c. 7.4 mg/L		1
White Mullet	TLm 24h	6.25 mg/L		4
White Mullet	TLm 48h	6.25 mg/L		4
Mosquito fish	LC_{50} 96h	10.0 mg/L		4
Killifish	TLm 24h	7.78 mg/L		4
Killifish	LC_{50} 48h	7.78 mg/L		1
Brown shrimp	EC_{50} 48h	1.0 mg/L		4
Oyster	EC_{50} 96h	>1.0 mg/L	Shell growth inhibition	4
Daphnia	*EC_{50} 48h*	*5.9 mg/L*		*1*

[i] TOXICITY (OTHER) — Produced a 23.8% decrease in phytoplankton productivity during 4 hours exposure at 1.0 mg/L.[4] Slight irritation of skin, eyes and mucous membranes (rabbits); not a skin sensitizer (guinea pigs).[1] Non-toxic to bees at 0.011 mg/bee.[1] Not likely to pose an acute risk to birds, most mammals or aquatic organisms.[5]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL — Rapidly metabolized. In one study, approximately 50% of compound administered to rats was expired as CO_2 in 3 days, while approximately 25% was excreted in urine and 5% in faeces.[1]

[ii] Plant — Rapidly metabolized to CO_2 and naturally occurring plant constituents. Resulted from hydrolysis and decarboxylation reactions on the alkyl or carbonyl groups of pebulate was detected in mung beans, wheat, corn and peas.[4]

8. ADDITIONAL INFORMATION

Similar in action to EPTC (Eptam). No contact activity.[3]

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. USEPA. 1999. R.E.D. Facts: Pebulate. Prevention, Pesticides and Toxic Substances. EPA-738-F99-009, September.
6. HSDB

Pendimethalin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — pendimethalin (BSI, E-ISO, WSSA, ANSI); pendimethaline (F-ISO)

[ii] TRADE NAME — Prowl, Valor (Cyanamid Crop Protection)

[iii] CHEMICAL NAME — *N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine

[iv] CAS # — 40487-42-1

[v] TYPE / MODE OF ACTION — Selective herbicide. Inhibits cell division and elongation.

2. USE PATTERN

Controls annual grasses and broad-leaved weeds in cereals, maize, carrots, potatoes, tobacco, and turf. Often used with dicamba, cyanazine, and atrazine.

[i] APPLICATION — Applied pre-plant, pre- and post-emergence. Do not apply by air. Apply with ground operated boom sprayers.

[ii] RATES — Soybean, 1.1 kg a.i./ha. Field corn, 1.68 kg a.i./ha.[2]

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 15-21 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Do not store below 4°C.[2] Very stable in storage; stable to acids and alkalis. Slowly decomposed by light.[1]

4. HANDLING PRECAUTIONS

Avoid contact with eyes, skin or clothing by wearing goggles, face shield and rubber gloves. Avoid breathing spray mist and wash thoroughly after handling.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Moderately persistent. Half-life is 3-4 months.[1] Pendimethalin is strongly absorbed by most soils and has low leaching potential.

[ii] AQUATIC — Half-life in water in a model ecosystem is two days.[3] Stable to hydrolysis. May bind to sediment and particulate matter. Not expected to bioaccumulate.

[iii] ATMOSPHERIC - When released in air during spraying, pendimethalin will occur in aerosols and be removed from the atmosphere by gravitational settling. It also partitions into tiny fog droplets and is removed from the atmosphere in rain. Vapor-phase pendimethalin reacts with photochemically-produced hydroxyl radicals, resulting in an estimated atmospheric half-life of 12.7 hours.[3]

[iv] PHYTODEGRADATION — Upon absorption, translocation is limited and pendimethalin is broken down by oxidation. Residues in plants at harvest are below 0.05 ppm.[4]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1250 mg/kg	Male	1
Rat	LD50 oral	1050 mg/kg	Female	1
Rat	NOEL 2y F.T.	100 mg/kg diet	No ill-effects	1
Rabbit	LD50 oral	>5000 mg/kg		1
Rabbit	LD_{50} dermal	>5000 mg/kg		1
Bobwhite quail	LC_{50} dietary 8d	4187 mg/kg diet		1
Mallard	LD_{50} oral	1421 mg/kg		4
Mallard	LC_{50} dietary 8d	10388 mg/kg diet		1
Rainbow trout	LC_{50} 96h	0.14 mg/L		1
Bluegill sunfish	LC_{50} 96h	0.2 mg/L		1
Fathead minnow	LC_{50} 96h	0.19 ug/L		3
Channel catfish	LC_{50} 96h	0.42 mg/L		1
Daphnia magna	*LC_{50} 48h*	*0.28 mg/L*		*4*

[i] TOXICITY (OTHER) – Non-irritating to skin and eyes (rabbits).[1] Slightly toxic to birds, highly toxic to fish and aquatic invertebrates, non-toxic to bees.[4] Unlikely to cause reproductive effects in humans under normal circumstances; does not appear teratogenic; no mutagenic activity; non-carcinogenic.[4]

[ii] PHYTOTOXICITY – Injury to maize may occur if used as a pre-plant, soil-incorporated treatment.[1]

7. METABOLISM

[i] ANIMAL - In rats given radiolabeled oral doses, pendimethalin residues were less than 0.3 ppm in all tissues except fat (0.9 ppm) after 96 hours.[3]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. PMRA
3. HSDB
4. PP

Permethrin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — permethrin

[ii] TRADE NAME — Talcord, Sanbar (Ciba-Geigy Canada Ltd.); Ectiban, Atroban (Coopers Agropharm Inc.); Pounce (Chemagro Ltd.); Ambush (Chipman Inc.); Siphex-14 (Janssen Pharmaceutica); Evercide (McLaughlin Gormley King Co.); Gardstar Ear Tag (Y-Tex Corp.)

[iii] CHEMICAL NAME — 3-phenoxybenzyl (1*RS*,3*RS*; 1*RS*,3*SR*)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate

[iv] CAS # — 52645-53-1

[v] TYPE / MODE OF ACTION — Synthetic pyrethroid compound used as a contact and stomach poison insecticide.

2. USE PATTERN

Controls army worms, aphids, budworms, bollworms, and many other insects on crop plants and ornamentals.

[i] APPLICATION — Apply to foliage when insects appear and repeat as necessary. Do not make more than 15 applications per season.

[ii] RATES — 0.056-0.22 kg a.i./ha; 0.625-2.5 g a.i./10 L water; 0.95 g a.i./ ear tag.

CARRIER: Water, ear tag, solid.

[iii] FORMULATIONS

1. SR
2. EC
3. WP
4. GR
5. PP
6. SN
7. SO

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 23-30 m
2. Air blast application: Calculated: 24(33)-31(41) m
3. Aerial application: Calculated: 400->1000 m
4. Forestry application: Not identified.

3. STORAGE

More stable in acidic than in alkaline media. Stable to heat.

4. HANDLING PRECAUTIONS

Keep out of lakes, streams, and ponds. Do not clean equipment or dispose of waste near a body of water. Wash thoroughly after handling. Avoid contact with eyes, skin, and clothing. Avoid breathing vapour or spray mist. Do not store near food, feed, heat, or open flame. Mixing with calcium nitrate is not recommended.[1]

5. ENVIRONMENTAL PERSISTENCE

Heat-labile factors (probably micro-organisms) more important than purely physical or chemical degradation.[4]

[i] SOIL – In soil and water degradation is rapid. DT_{50} in soil <38 days.[1] Of low to moderate persistence in soil, reported half-lives of 30 to 38 days; readily broken down in most soils except organic types.[7] Tightly bound by soils leading to very little leaching.[7]

[ii] AQUATIC – Degradation is rapid.[1] Half-life of less than 2.5 days; when exposed to sunlight the half-life was 4.6 days. Permethrin can persist in sediments.[7]

[iii] ATMOSPHERIC – If released to air permethrin will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase permethrin will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals and ozone; the half-lives for these reactions in air are estimated to be 9.8 hours and 49 days, respectively. Particulate-phase permethrin will be removed from the atmosphere by wet and dry deposition.[8]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	430-4000 mg/kg	cis/trans ratio 40:60	1
Rat	LC_{50} inhalation 3h	>685 mg/m^3 air	Aerosol	1
Rat	LD_{50} dermal	>4000 mg/kg		
Rat	NOEL 2y F.T.	100 mg/kg diet	No ill-effects	1
Mouse	LD_{50} oral	540-2690 mg/kg	cis/trans ratio 40:60	1
Rabbit	LD_{50} dermal	>200 mg/kg		
Human	ADI	0.05 mg/kg b.w.		6
Mallard	LD_{50}	>23000 mg/kg		
Chicken	LD_{50} oral	>3000 mg/kg	cis/trans ratio 40:60	1
Japanese quail	LD_{50} oral	>13500 mg/kg	cis/trans ratio 40:60	1
Rainbow trout	LC_{50} 96 h	2.5 μg/L		1
Atlantic salmon	LC_{50} 48h	0.009 mg/L		5
Lobster	LC_{50} 96h	0.73 μg/L		5
Larch sawfly	LD_{50} 72h	0.023 mg/kg	IV instar	
Larch sawfly	LD_{50} 72h	0.039 mg/kg	V instar	
Red-headed pine sawfly	LD_{50} 72h	0.014 mg/kg	IV instar	
Sweine jackpine sawfly	LD_{50} 72h	0.023 mg/kg	IV instar	
Rusty tussock moth	LD_{50} 72h	0.004 mg/kg	IV instar	
Bruce spanworm	LD_{50} 72h	0.011 mg/kg	IV instar	
Spruce budworm	LD_{50} 72h	0.045 mg/kg	II instar	
Spruce budworm	LD_{50} 72h	0.015 mg/kg	III instar	
Spruce budworm	LD_{50} 72h	0.013 mg/kg	V instar	
Jack pine sawfly	LD_{50} 72h	0.015 mg/kg	V instar	
Jack pine sawfly	LD_{50} 72h	0.020 mg/kg	IV instar	

[i] TOXICITY (OTHER) — The formulation SBP-1513 is toxic to fish. Causes mild eye and skin irritation. Highly toxic to predatory mite but not to prey (spider mite) on apple when sprayed pre-bloom; this led to spider mite outbreak later in season.[2] Toxic to bees.[1] Practically non-toxic to birds, renders aquatic ecosystems vulnerable.[7] No teratogenic activity, no mutagenic activity.[7]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL – Metabolism by esterase and oxidase action usually limits pyrethroid toxicity to mammals more than to insects, hence the differential toxicity.[3] In oral administration to rats, permethrin is rapidly metabolized and almost completely eliminated from the body in a few days.[7]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Good residual activity; sunlight does not break it down rapidly. Non-systemic with no fumigant activity. Most effective against Lepidoptera.

9. REFERENCES

1. PM
2. Aliniaze, M.T. and J.E. Cranham (1980) Effect of four synthetic pyrethroids on a predatory mite, *Typhlodromus pyri*, and its prey, *Panonychus ulmi*, on apples in southeast England. *Environ. Entomol.* 9: 436-439.
3. Casida, J.E. and L.O.Ruzo (1980) Metabolic chemistry of pyrethroid insecticides. *Pestic. Sci.* 11: 257-269.
4. Chapman, R.A., C.M. Tu, C.R. Harris and C.Cole (1981) Persistence of five pyrethroid insecticides in sterile and natural, mineral and organic soil. *Bull. Environ. Contam. Toxicol.* 26: 513-519.
5. McLeese, D.W., C.D. Metcalfe and V. Zitko (1980) Lethality of permethrin, cypermethrin and fenvalerate to salmon, lobster and shrimp. *Bull. Environ. Contam. Toxicol.* 25: 950-955.
6. Pesticide Residues in Food-1986. Evaluations 1986. Part I, Residues, FAO Plant. Prod. Prof. Pap., Vol 78: 359. Annex I.
7. PP
8. HSDB

Phorate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — phorate (BSI, E-ISO, F-ISO, ANSI, ESA); timet (former exception, USSR)

[ii] TRADE NAME — Thimet, *Cygard* (BASF Canada)

[iii] CHEMICAL NAME — *0,0*-diethyl *S*-ethythiomethyl phosphorodithioate

[iv] CAS # — 298-02-2

[v] TYPE / MODE OF ACTION — Soil and systemic organophosphorus insecticide and acaricide (phosphorodithioate). Cholinesterase inhibitor with contact and stomach action.

[vi] NOTICE — In Canada, phorate end-use products were re-evaluated in 1999. This re-evaluation proposed that phorate uses on corn, lettuce, beans, and rutabaga be phased out by the end of 2003, as alternative pesticides exist. Since few alternative pest management products (especially for wireworms) are available for potatoes, use of phorate for potatoes is to be phased out by the end of 2004. **Phorate products registration expired December 31, 2002.**

2. USE PATTERN

Use on potatoes only.

[i] APPLICATION — SOIL: Band, each side of row at planting. Avoid direct contact with seed. Use high rates on heavier soils. Side dressing, incorporate deep enough not to be disturbed by future cultivation. Irrigate as soon as possible. FOLIAGE: Apply when dry to direct granular material into plant crowns. Spray when insects appear and repeat as necessary. SEED: Coat seeds thoroughly before planting. Sticker may be added.

[ii] RATES — Potato 2.34-4.31 kg a.i./ha. [2]

CARRIER: Not identified.

[iii] FORMULATIONS

1. GR
2. Also sold combined with fertilizers and fungicides.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 33-39 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 480-500 m
4. Forestry application: Not identified.

3. STORAGE

At room temperature, technical grade is stable at least 2 years [2]. Subject to hydrolysis under alkaline (>pH 9) or acid (<pH 2) conditions.

4. HANDLING PRECAUTIONS

Do not graze livestock on treated crops. Keep treated seed out of reach of animals. Keep away from open flame. Use on ornamentals should be by professional nursery operators only.

5. ENVIRONMENTAL PERSISTENCE

4-12 weeks protection. Environmental stability optimum at pH 5-7.

[i] SOIL — Oxidized rapidly to sulphoxide and sulphone. Six months after treatment the highest phorate concentration is in the top 2.5 cm. Sulphoxide and sulphone are leached downwards; highest sulphone concentration at 75-0-7.5 cm.[4] Phorate is degraded in soil by *Pseudomonas* spp., the major metabolite being phorate sulfoxide.

[ii] AQUATIC – The half-life of phorate in acidic water solutions is between a few days and a few weeks, depending on temperature; the half-life in alkaline water may be much shorter. Phorate is degraded by waterborne microorganisms and hydrolysis.[5]

[iii] ATMOSPHERIC - If released to the atmosphere, phorate is expected to exist solely in the vapor-phase in the ambient atmosphere. Vapor-phase phorate is expected to be rapidly degraded by reaction with photochemically-produced hydroxyl radicals (estimated half-life ~1.5 hours).[3]

[iv] PHYTODEGRADATION — In one study, sulphoxide and sulphone were found in bark and needles of Douglas fir. Concentration increased between 1 to 7 months after treatment. Sulphoxide not detected in new plant tissue 13 and 17 months after treatment, while sulphone decreased from 0.17 mg/kg after 13 months to <0.1 mg/kg by 17 months.[4]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	3.7 mg/kg	Males	1
Rat	LD_{50} oral	1.6 mg/kg	Females	1
Rat	NOEL 90d F.T.	6.0 mg/kg diet	Depression of ChE levels	1
Guinea pig	LD_{50} dermal	20.0-30.0 mg/kg		1
Rabbit	LD_{50} dermal	5.6 mg/kg	Males	1
Rabbit	LD_{50} dermal	2.9 mg/kg	Females	1
Mallard	LD_{50} oral	0.62 mg/kg		1
Pheasant	LD_{50} oral	7.1 mg/kg		1
Chukar	LD_{50} oral	12.8 mg/kg		3
Rainbow trout	LC_{50} 96h	0.013 mg/L		1
Bluegill	LC_{50} 96h	0.002 mg/L		3
Largemouth bass	LC_{50} 96h	0.005 mg/L		3
Northern pike	LC_{50} 96h	0.11 mg/L		3
Channel catfish	LC_{50} 96h	0.28 mg/L		1
Stonefly	LC_{50} 96h	0.004 mg/L		3
Gammarus fasciatus	*LC_{50} 96h*	*0.004 mg/L*		*3*

[i] TOXICITY (OTHER) — Thimet and its formulations are highly poisonous by skin contact, inhalation, or swallowing; rapidly absorbed through skin and eyes. Cholinesterase inhibitor. Toxic to bees. Non-mutagenic, non-teratogenic, non-carcinogenic.[1]

[ii] PHYTOTOXICITY — Treated plants are apparently stimulated. Slight chlorosis (soon outgrown) occurs on some seedlings. Injury may occur on tobacco, and apples. Injury may occur if granules come in direct contact with seed of beans, corn, lettuce, tomatoes, and sugar beets.

7. METABOLISM

[i] ANIMAL – Expected to undergo hydrolytic degradation in the liver and other tissues, usually within hours of administration.[3] In both plants and animals, oxidized at thioether linkage and coordinated sulphur yielding sulphoxide and sulphone and their phosphorothioate analogues. As both parent compound and oxidation products are readily hydrolyzed only small proportions of sulphone results, but sulphones can persist under some conditions.[1]

[ii] PLANT – Plants metabolize phorate to very potent anticholinesterase agents such as the sulfoxide and sulfone derivatives of the compound.[5]

8. ADDITIONAL INFORMATION

Compatibility no problem because phorate is usually applied as granular material.

9. REFERENCES

1. PM
2. PMRA
3. HSDB
4. Getzin, L.W. and J.L. Saunders (1977) Translocation, distribution and metabolism of phorate in Douglas fir. *For. Sci.* 23: 355-362.
5. PP

Phosalone

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — phosalone (BSI, E-ISO, F-ISO, ANSI, ESA, JMAF); benzofos (former exception, USSR)

[ii] TRADE NAME — Zolone, Azofene, Rubitox (Rhone-Poulenc Inc)

[iii] CHEMICAL NAME — *S*-6-chloro-2,3-dihydro-2-oxo-1,3-benzoxazol-3-yl methyl *O,O*-diethyl phosphorodithioate

[iv] CAS # — 2310-17-0

[v] TYPE / MODE OF ACTION — Non-systemic organophosphorus insecticide and acaricide (dithiophosphate group)

[vi] NOTICE — Phosalone is **currently under re-evaluation** in Canada. In the United States, phosalone is not found as an active ingredient in any registered products.

2. USE PATTERN

Used for the pre-harvest control of a wide range of pests in agriculture, horticulture, and viticulture. Limited use against animal ectoparasites. Insects controlled include mites, aphids, leafhoppers, peach twig borer, codling moth, pear psylla, plum curculio, and apple maggot. Rapid killing action; 12-20 days control expected.

[i] APPLICATION — Apply evenly and thoroughly in sufficient water to ensure coverage. Repeat as necessary.

[ii] RATES — 0.975-1.5 g a.i./L

CARRIER: Water

[iii] FORMULATIONS

1. SU
2. WP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Not identified.
2. Air blast application:	Calculated: 5(12)-7(16) m
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Do not store below 0°C. Do not store or transport with plants, seeds, or foodstuffs. Stable under normal conditions. Hydrolysed by strong alkalis and acids.[1]

4. HANDLING PRECAUTIONS

Do not allow livestock to graze treated areas. Do not use with surfactants. Compatible with most other pesticides.

5. ENVIRONMENTAL PERSISTENCE

Readily decomposed in soil and in animals.

[i] SOIL – Low mobility in soils; strongly adsorbed and rapidly degraded; DT_{50} approximately 1-4 days.[1]

[ii] AQUATIC – If released in water, phosalone would adsorb to sediment and particulate matter in the water column and photolyze in surface layers of water.[5]

[iii] ATMOSPHERIC – When phosalone is released into the atmosphere as an aerosol during spraying, it will be removed by gravitational settling. It will degrade by direct photolysis to produce phosalone-oxon with an estimated half-life of 86 minutes. Vapor phase phosalone would react with photochemically produced hydroxyl radicals with an estimated half-life of 2.2 hours.[5]

[iv] PHYTODEGRADATION — Persists on plants for about 14 hours. Metabolized to the corresponding phosphorothioate which is rapidly hydrolyzed.[4]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50}	120-170 mg/kg	Males	1
Rat	LD_{50} dermal	1500 mg/kg		1
Rat	NOEL 2y F.T.	250 mg/kg diet	No ill-effects	1
Rat		1.25 mg/kg/d	No effect level	3
Mouse	LD_{50} oral	180 mg/kg		1
Guinea pig	LD_{50} oral	150 mg/kg		1
Rabbit	LD_{50} dermal	1530 mg/kg		2
Dog	NOEL 2y F.T.	290 mg/kg diet	No ill-effects	1
Dog		0.625 mg/kg/d	No effect level	3
Human	ADI	0.006 mg/kg		3
Pheasant	LD_{50} oral	290 mg/kg		1
Rainbow trout	LC_{50}	0.3-0.63 mg/L		1
Daphnia	EC_{50} 48h	*0.0012 ppm*		*1*

[i] TOXICITY (OTHER) — Acute toxic effects in rodents potentiated with several organophosphorus compounds, particularly Di-Syston. No effects on rat reproduction and no teratogenic effect in chick or rat. Not neurotoxic to chickens. Toxic to fish. Rates of 700 g/ha not hazardous to honey bees provided worker bees are not actively foraging at time of spraying.[1] Moderately toxic to worms.[1]

[ii] PHYTOTOXICITY — Non-phytotoxic when used at the recommended application rates.[1] Injury to a number of plants including Golden Delicious and other yellow apple varities[1] when used at higher than recommended rates.

7. METABOLISM

[i] ANIMAL – Rapidly absorbed, metabolized, and excreted in rodents. Rapidly eliminated, primarily via urine.[1] Residues of potential toxicity are composed of the parent compound and, to a minor extent, an oxon derivative.

[ii] PLANT – Rapidly degraded via oxidation, cleavage, hydrolysis and dechlorination.[1]

8. ADDITIONAL INFORMATION

Pesticidal activity on plants lasts 2-3 weeks, depending on type of pest. Practically no contamination of animal tissues occurs as a result of feeding animals fodder crops containing phosalone residues. Activity is not modified by low temperatures.

9. REFERENCES

1. PM
2. FCH
3. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO meeting on pesticide residues. II. Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews* 63: 1-44.
4. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
5. HSDB

Phosmet

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — phosmet (BSI, E-ISO, F-ISO, ESA); phtalofos (USSR); PMP (JMAF)

[ii] TRADE NAME — Imidan (Gowan Co.); Louse Kill (Dispar); Prolate, Starbar, Vet-Kem; *Fruit Plus* (Stauffer Chemical Co.)

[iii] CHEMICAL NAME — *0,0*-dimethyl *S*-phthalimidomethyl phosphorodithioate

[iv] CAS # — 732-11-6

[v] TYPE / MODE OF ACTION — Organophosphorus contact insecticide (phosphorodithioate group).

[vi] NOTICE — It has been determined that phosmet exposure poses potential human and ecological risks. **Domestic products have been discontinued in Canada,** sales ended in November, 2002. **Commercial uses are under re-evaluation.** The US EPA has consequently altered phosmet use patterns to include the voluntary cancellation of certain uses, continued registered uses with additional risk reduction, as well as continued uses under time-limited registrations including interim risk mitigation.

2. USE PATTERN

Used against a wide range of insects, including alfalfa weevil, codling moth, leafrollers, plum curculio, grape berrymoth, and oriental fruit moth, on a variety of fruit, vegetable, and field crops and certain deciduous shade trees, ornamental trees, and woody evergreens. Also used on domestic pets.

[i] APPLICATION — With common application equipment to give uniform coverage. Repeat as necessary. On livestock use as a pour-on treatment, as a spray, or in back rubbers. Apply topically to animals.

[ii] RATES — 2.2 kg a.i./ha [3]; 0.5-1.0 kg a.i./ha.[6]; 3.48 mL a.i./13.8 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. SN
3. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 2-12 m
2. Air blast application:	Calculated: 4(10)-12(21) m
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Hydrolyzed in aqueous solutions. Slightly corrosive. Compatible with other pesticides except under alkaline conditions. Storage above 45°C may lead to decomposition. Rapidly hydrolysed in alkaline media; relatively stable in acidic conditions. Decomposes in sunlight in aqueous solution or on glass plates.[1]

4. HANDLING PRECAUTIONS

Do not treat young, stressed, or sick animals. Do not treat dairy animals. Do not graze livestock in treated orchards. Avoid drift. Do not apply when rain is expected or before leaf surfaces are dry. Do not combine with alkaline material (lime sulphur, etc.).

5. ENVIRONMENTAL PERSISTENCE

Readily degraded in the environment.

[i] SOIL – Phosmet is of low persistence in the soil environment with a half-life of 4 to 20 days. Rapidly broken down in soil to non-toxic products. Degradation is by hydrolysis and microbial action. Little leaching is expected.[7]

[ii] AQUATIC – Rapidly broken down by the chemical action of water and sunlight (hydrolysis and photolysis). Under alkaline conditions (pH 9), the half-life is reported as 16 hours.[7]

[iii] ATMOSPHERIC - If released to the atmosphere, phosmet will degrade rapidly in the vapor-phase by reaction with

photochemically produced hydroxyl radicals (Half-life of about 2.6 hours). Particulate-phase phosmet and aerosols released to air during spray applications of phosmet insecticides will be physically removed from air by dry and wet deposition.[8]

[iv] PHYTODEGRADATION — Residues on maize rapidly decline before ensiling, but are persistent after ensiling (Half-life ~92 days).[5]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	147-316 mg/kg		2
Rat	NOEL 2y	40.0 mg/kg diet		1
Rabbit	LD_{50} dermal	>4640 mg/kg		2
Dog	NOEL 2y	40.0 mg/kg diet		1
Bobwhite quail	LC_{50} 5d	507 mg/kg diet		1
Human	ADI	0.02 mg/kg b.w.		1
Rainbow trout	LC_{50} 96h	0.23 mg/L		1
Rainbow trout	LC_{50} 96h	>10000 μg/L	Eggs and yolk-sac fry; tech. grade	4
Rainbow trout	LC_{50} 24h	760 μg/L	Fingerlings; tech. grade	4
Rainbow trout	LC_{50} 96h	560 μg/L	Fingerlings	4
Bluegill sunfish	LC_{50} 96h	0.07 mg/L		1
Bluegill	LC_{50} 96h	0.42 mg/L		4
Chinook salmon	LC_{50} 24h	180 μg/L	Tech. grade	4
Channel catfish	LC_{50} 24h	13000 μg/L	Tech. grade	4
Channel catfish	LC_{50} 96h	11000 μg/L	Tech. grade	4
Fairy shrimp	EC_{50} 48h	3200 μg/L		4
Daphnia	*EC_{50} 48h*	*8.5 μg/L*		*1*

[i] TOXICITY (OTHER) — Toxic to fish, aquatic organisms, wildlife, and bees. Accumulation factors after 24 hours ranged from 10.0 (fathead minnow, channel catfish, and bluegill) to 1.0 (damsel fly). Accumulation factors after 48 hours ranged from 11.0 (channel catfish) to 2.0 (clam shrimp, damsel fly).[4] Does not cause reproductive toxicity, not likely to cause teratogenic effects.[7]

[ii] PHYTOTOXICITY- Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL – Readily degraded in laboratory animals.[6] In cattle, feeding of alfalfa with residues greater than double the level of the current 20.0 mg/kg MRL (Maximum Residue Limit) appears not to result in milk residues exceeding the 0.02 mg/kg limit for milk. These levels do not appear to affect the health of the cattle.[5] Rapidly absorbed, distributed and eliminated in mammals.[7]

[ii] PLANT – Rapidly broken down to non-toxic metabolites.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Julin, A.M. and H.O. Sanders (1977) Toxicity and accumulation of the insecticide Imidan in freshwater invertebrates and fishes. *Trans. A. Fish Soc.* 106: 386-392.
5. Pesticide Residues in Food-1986. Evaluations 1986. Part I, Residues, FAO Plant. Prod. Prof. Pap., Vol 78, 1986. pp. 255-267.
6. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
7. PP
8. HSDB

Picloram

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — picloram (BSI, E-ISO, ANSI, WSSA, JMAF); piclorame (F-ISO)

[ii] TRADE NAME — Tordon, Grazon (Dow Chemical Co.)

[iii] CHEMICAL NAME — 4-amino-3,5,6-trichloropyridine-2-carboxylic acid

[iv] CAS # 1918-02-1

[v] TYPE / MODE OF ACTION— Restricted use herbicide, selective in action, useful for the control of many broadleaf plants and conifers in established grass plantings. The herbicidal action is a result of absorption through leaves from foliar sprays, uptake through the roots from soil, and residual activity in the soil.[3]

[vi] NOTICE — **Granular formulations are no longer registered in Canada.**

2. USE PATTERN

For general woody plant control and control of most annual and perennial broadleaf weeds in cropland and non-crop areas, flax, rangeland, and pastures.[3]

[i] APPLICATION — Liquid sprays can be applied aerially, or by ground equipment, knapsack equipment, and tree injectors. Liquid formulations can be applied under conditions favourable for plant growth anytime up to 3 weeks before frost.

[ii] RATES — Liquid sprays applied at rates of 0.264-2.16 kg a.i./ha.

CARRIER: liquid salt formulations are applied in water sprays.

[iii] FORMULATIONS

1. PE
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Not identified.
3. Aerial application:	Calculated: 0 m
4. Forestry application:	Not identified.

3. STORAGE

Can be stored for a minimum of 2 years. Decomposes at 215°C. Low solubility. Non-corrosive, non-flammable, and subject to photodegradation. Very stable to acids and alklais, but decomposed by hot concentrated alkalis. In aqueous solution, decomposed by ultraviolet irradiation.[1]

4. HANDLING PRECAUTIONS

Avoid drift. Do not use the same equipment to apply other pesticides. Do not apply where surface water from the treated area can run off onto cropland.

5. ENVIRONMENTAL PERSISTENCE

Degradation by microorganisms occurs slowly. Breakdown occurs in UV light.[4] This chemical is non-volatile.[3]

[i] SOIL — 5.6 kg/ha persisted to >568 days. Estimated persistence of 18 months.[7] Disappearance from soil is more rapid under warm, humid conditions in the south and slowest under cold, dry conditions in the north. Known to persist from 2-5 years. Moderately to highly persistent in the soil environment, half life from 20 to 300 days; photodegradation is significant only on the soil surface and volatilization is absent.[5] May pose a risk to groundwater contamination.[5]

[ii] AQUATIC – Sunlight readily breaks down picloram; with a half-life of 2.6 days.[5]

[iii] ATMOSPHERIC - If released to the atmosphere it will be subject to significant deposition and washout due to its low vapor pressure (will adsorb to particulate matter) and significant water solubility. It may also be subject to significant direct photolysis. The estimated vapor phase half-life in the atmosphere is 12.21 days as a result of reaction with photochemically produced hydroxyl radicals.[6]

[iv] PHYTODEGRADATION — Applied at a rate of 2.24 kg/ha, it affected barley, alfalfa, and soybeans for nine months after application.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	8200 mg/kg	Female	2
Mouse	LD_{50} oral	2000-4000 mg/kg		1
Guinea pig	LD_{50} oral	c.300 mg/kg		1
Rabbit	LD_{50} oral	c. 2000 mg/kg		1
Rabbit	LD_{50} dermal	c. 3000 mg/kg		1
Sheep	LD_{50} oral	>1000 mg/kg		1
Cattle	LD_{50} oral	>750 mg/kg		1
Mallard	LC_{50}	>5000 mg/kg		1
Chick	LD_{50} oral	c. 6000 mg/kg		1
Rainbow trout	LC_{50} 96h	29.2 mg/L	Triethylamine salt	2
Rainbow trout	LC_{50} 24h	150 mg/L		
Rainbow trout	LC_{50} 48h	2.5 mg/L		
Brown trout	LC_{50} 24h	240 mg/L		
Brown trout	LC_{50} 24h	420 mg/L		
Cutthroat trout	LC_{50} 96h	6.50 mg/L	5°C	
Cutthroat trout	LC_{50} 96h	5.00 mg/L	10°C	
Cutthroat trout	LC_{50} 96h	4.10 mg/L	15°C	
Cutthroat trout	LC_{50} 96h	8.60 mg/L	pH 6.5	
Cutthroat trout	LC_{50} 96h	4.70 mg/L	pH 7.5	
Cutthroat trout	LC_{50} 96h	4.15 mg/L	pH 8.5	
Lake trout	LC_{50} 96h	3.60 mg/L	5°C	
Lake trout	LC_{50} 96h	4.25 mg/L	10°C	
Lake trout	LC_{50} 96h	2.35 mg/L	15°C	
Lake trout	LC_{50} 96h	4.95 mg/L	pH6.5	
Lake trout	LC_{50} 96h	2.70 mg/L	pH7.5	
Lake trout	LC_{50} 96h	2.05 mg/L	pH8.5	
Fathead minnow	LC_{50} 96h	55.3 mg/L		1
Harlequin fish	LC_{50} 24h	66.0 mg/L		
Green sunfish	LC_{50} 24h	420 mg/L		
Black bullhead	LC_{50} 24h	420 mg/L		
Stonefly	LC_{50} 24h	120 mg/L	Nymphs	
Gammarus lacustris	*LC_{50} 48h*	*48.0 mg/L*		
Daphnia	*EC_{50} 48h*	*50.7 mg/L*		*1*

[i] TOXICITY (OTHER) — Low toxicity to aquatic animals and wildlife. Non-toxic to birds.[5] In feeding trials, no ill-effects were noted on sheep, pigs, cattle, or poultry. May cause moderate irritation to eyes but it heals readily. If dusts are inhaled they may be somewhat irritating but not likely to cause illness. Mild skin irritation but does not sensitize. Practically non-toxic to earthworms.[1] Does not appear to cause reproductive toxicity, non-teratogenic, non-mutagenic (or weakly mutagenic), non-carcinogenic (or weakly carcinogenic).[5]

[ii] PHYTOTOXICITY — Very minute quantities will injure most sensitive broadleaved crops, except crucifers.

7. METABOLISM

[i] ANIMAL - It takes 7 days for the chemical to leave the urine of livestock grazing a treated area, therefore do not move them directly from a treated to an untreated area.[3]

[ii] PLANT – On plants surfaces, photodecomposition occurs, possibly with cleavage of the pyridine ring.[1] Picloram remains stable and intact in plants.[5]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Wirthgen, B. and W. Raffke (1977) Zur Rueckstandsbildung der Herbizide und ihrer lebensmittelhygienisch-toxikologischen Bedeutung. 1. Allgemeines, Wirkungsmechanismen, Toxikologie und Metabolismus. (Determination of the terminal residues of herbicides and their toxicological importance in foodstuffs. 1. General mechanisms of action, toxicology and metabolism). *Nahrung* 21: 443-450.
5. PP
6. HSDB
7. IH

Pirimicarb

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — pirimicarb (BSI, E-ISO, ANSI, JMAF); pirimicarbe (F-ISO); pyrimicarbe (France)

[ii] TRADE NAME — Pirimor, *Rapid Aphid Killer* (Syngenta Crop Protection Canada)

[iii] CHEMICAL NAME — 2-dimethylamino-5,6-dimethylpyrimidin-4-yl dimethylcarbamate

[iv] CAS # — 23103-98-2

[v] TYPE / MODE OF ACTION — A carbamate compound used as a systemic insecticide and aphicide.

2. USE PATTERN

Fast-acting selective aphicide, particularly against organophosphorus-resistant strains. Contact and vapour action. No acaricidal or fungicidal properties. Used on food/feed crops and tobacco.

[i] APPLICATION — Apply when insects appear, repeat as necessary. Used experimentally as a soil drench.

[ii] RATES — 75.0-850 g a.i./ha in 17-1000 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. PP
3. SU

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 0 m
2.	Air blast application:	Calculated: 0 m
3.	Aerial application:	Calculated: 0 m
4.	Forestry application:	Not identified.

3. STORAGE

Aqueous solution is unstable to light.[2] Non-corrosive to normal spray equipment. Stable under normal conditions for more than 2 years; hydrolytically stable at pH 4-9.[1]

4. HANDLING PRECAUTIONS

Highly toxic, may be fatal if inhaled, swallowed or absorbed through skin. Avoid any skin contact.[5] Compatible with most common, neutral insecticides, fungicides, and acaricides.[5]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – If released to soil, pirimicarb is expected to have high to low mobility in soil based on K_{oc}. Soils low in organic matter and high in clay content tend to adsorb pirimicarb more strongly than do soils rich in organic matter. Volatilization of pirimicarb from moist soil surfaces is not expected to be an important fate process. Pirimicarb is not expected to volatilize from dry soil based on its vapor pressure. Biodegradation data on pirimicarb in soils suggest that the rate of degradation varies greatly depending upon the conditions of the soil, with half-lives ranging from several days to several months.[5]

[ii] AQUATIC – If released into water, pirimicarb is expected to adsorb to suspended solids and sediment based upon the K_{oc}. Volatilization from water surfaces is not expected to be an important fate process. Photolysis in sunlit surface water may be an important fate process for pirimicarb based on a photolysis half-life of less than 1 day in aqueous solution. Hydrolysis of pirimicarb is reported to occur slowly in water.[5]

[iii] ATMOSPHERIC – If released to air pirimicarb will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase pirimicarb will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 2 hours. Particulate-phase pirimicarb will be removed from the atmosphere by wet and dry deposition. Pirimicarb absorbs light greater than 290 nm and may also be susceptible to photolysis in the environment.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	147 mg/kg	Females	1
Rat	LD$_{50}$ dermal	>500 mg/kg		1
Rat	NOEL 2y	250 mg/kg diet (12.5 mg/kg/d)		1
Mouse	LD$_{50}$ oral	107 mg/kg		1
Rabbit	14d dermal	500 mg/kg	No toxic symptoms	4
Dog	LD$_{50}$ oral	100-200 mg/kg		1
Dog	NOEL 2y	1.8 mg/kg/d		1
Human	ADI	0.02 mg/kg b.w.		1
Poultry	LD$_{50}$ oral	25.0-50.0 mg/kg		1
Mallard	LD$_{50}$ oral	17.2 mg/kg		1
Bobwhite quail	LD$_{50}$ oral	8.2 mg/kg		1
Bluegill	LC$_{50}$ 96h	55.0 mg/L		1
Rainbow trout	LC$_{50}$ 96h	29.0 mg/L		1
Daphnia	*EC$_{50}$ 24h*	*0.08 ppm*		*1*

[i] TOXICITY (OTHER) — Cholinesterase inhibitor. Does not harm lady birds or lacewings. Rats exposed to air which had passed over technical pirimicarb (6 hrs/day, 5 days/week for 21 days) show no toxic signs nor depression of ChE levels.[4] Not irritating (5.0 g tech./L) to rabbit eye.[4] Non-irritating to skin; moderate skin sensitizer (guinea pigs).[1] Relatively non-toxic to beneficial predators, parasites, and bees.[2] Unlikely to be teratogenic.[5]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT - Absorbed by the roots, and translocated through the xylem. Penetrates the leaves, but is not translocated extensively.[5]

8. ADDITIONAL INFORMATION

Fast acting with relatively short residual activity. Ideal for use in greenhouses. May be applied with other pesticides.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
5. HSDB

Polybutene

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — polybutene

[ii] TRADE NAME — Waco Bird Repellent (Abell Pest Control). Other names include 4 the Birds, Hot Foot, Tree Tanglefoot, and Roost Nomore.

[iii] CHEMICAL NAME — polymerized butanes

[iv] CAS # - 9003-29-6

[v] TYPE / MODE OF ACTION - Adhesive rodenticide and insecticide.

2. USE PATTERN

Used on non-cropland, in and around farm buildings, and food processing/handling establishments. Used in combination with other materials to repel sparrows, pigeons, and starlings from urban roosts. Also used on cables to repel squirrels which would use it as a runway. Spray applications have controlled the two-spotted spider mite on *Eunoymus japonica* in greenhouses.[1]

[i] APPLICATION — Apply as a paste.

[ii] RATES — 2.0-4.0 kg/$100m^3$.

CARRIER: Paste.

[iii] FORMULATIONS

1. PA
2. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Begins to decompose at approximately 350°C.[1]

4. HANDLING PRECAUTIONS

Personal protective gear includes: goggles or face shield.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

[i] TOXICITY (OTHER) – Vapor may act as a simple asphyxiant in high concentration.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. HSDB

Prometryn

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — prometryn (BSI from 1984, E-ISO, ANSI, WSSA); prometryne (F-ISO, JMAF)

[ii] TRADE NAME — Gesagard (Syngenta Crop Protection Canada Inc.)

[iii] CHEMICAL NAME — N^2, N^4-di-isopropyl-6-methylthio-1,3,5-triazine-2,4-diamine

[iv] CAS # — 7287-19-6

[v] TYPE / MODE OF ACTION — Triazine compound used as a selective pre- and post-emergence herbicide.

2. USE PATTERN

Used on celery, corn, and bluegrass grown for seed.

[i] APPLICATION — Apply as either a band or broadcast treatment before weed seedlings emerge. Use heavier rates on heavier soils. As a layby or post-emergence spray, apply before weeds are 5 cm high. Use in this manner as a directed spray. A surfactant may be added for post-emergence application. Also used as a pre-plant treatment in some areas. To celery, apply post-emergence when crop has true leaves or within 2-6 weeks after transplanted. On corn, use only pre-emergence.[3] Soil incorporation is not necessary under most conditions.[3]

[ii] RATE — 1.2-3.4 kg a.i./ha in 200-1000 L water.

CARRIER: Water at 225-450 L/ha is usual carrier for uniform application. Agitation in the spray tank is necessary to keep the chemical in suspension.

[iii] FORMULATIONS

1. WP
2. Also formulated with MSMA.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Very stable over several years of shelf-life, with only slight sensitivity to natural light and extreme temperatures which would occur normally. Non-flammable and non-corrosive under normal use conditions.

4. HANDLING PRECAUTIONS

Used as a directed spray on cotton while it is young to avoid any foliar injury. Do not apply after weeds have emerged. Sprangletop is not controlled by this material. Do not use pre-emergence on light, sandy soils. Do not graze or feed forage from treated areas to livestock. Agitate while spraying.

5. ENVIRONMENTAL PERSISTENCE

Residual carryover will not persist into the following season. Photodecomposition and volatilization are thought to be relatively insignificant fate processes.[4]

[i] SOIL — More readily adsorbed in soils with high clay and organic content, especially where soil pH is near 4. Sixty to ninety day weed control may be expected. Adsorbed to a greater extent than most other triazine herbicides. Leaching limited by adsorption.[4] Soil microorganisms play an important role in soil breakdown. Several soil microorganisms can utilize prometryn and either indirectly or directly influence the rate of degradation via hydroxylation and dealkylation.[4] Residual activity lasts 1-3 months under most normal conditions. Will persist longer under dry or cold conditions.

[ii] AQUATIC – No significant hydrolysis.

[iii] ATMOSPHERIC - If released to air prometryne will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase prometryne will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 10 hours. Particulate-phase prometryne will be physically removed from the atmosphere by wet and dry deposition.[7]

[iv] PHYTODEGRADATION — Usually metabolized by tolerant plants and to a lesser extent by sensitive plants by oxidation of methylthio group to hydroxy-metabolites and by dealkylation of the side chain. Plant degradation is generally slow; probably not a major selectivity mechanism.[4]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	5233 mg/kg		1
Rat	LD_{50} dermal	>3100 mg/kg		1
Rat	NOEL 2y	1250 mg/kg diet		1
Dog	NOEL 2y	150 mg/kg diet		1
Bobwhite quail	LC_{50} dietary 5-7d	16140 mg/kg		1
Rainbow trout	LC_{50} 96h	2.5 mg/L		2
Bluegill sunfish	LC_{50} 96h	10.0 mg/L		2
Carp	LC_{50} 96h	8.0 mg/L		1
Daphnia	*EC_{50} 48h*	*12.66 mg/L*		*1*

[i] TOXICITY (OTHER) — Non-toxic to birds, moderately toxic to fish, non-toxic to bees and earthworms.[6] Non-irritating to skin. Prometryn is unlikely to cause reproductive effects, does not appear to be teratogenic, mutagenic, or carcinogenic.[6]

[ii] PHYTOTOXICITY – Used as directed spray on cotton while young, to avoid foliar injury.[1]

7. METABOLISM

[i] ANIMAL – In rats, most of the herbicide is excreted in urine and faeces within 48 hours of administration.[6]

[ii] PLANT – Metabolised by tolerant plants, and, to a lesser extent, by sensitive plants, by oxidation of the methylthio group to hydroxyl metabolites, and by dealkylation of the side-chains. Degradation in plants is generally slow.[1]

8. ADDITIONAL INFORMATION

Water solubility is 48.0 mg/L. Soil incorporation is not necessary under most conditions. No harmful effects have been noticed when it is sprayed on the lower cotton bolls. Grasses will be the first weeds to appear in the treated areas. Rainfall or sprinkler irrigation will move this material into the soil. Non-corrosive. Absorbed by the roots as well as giving a foliar kill. More effective on broadleaves than grasses. Does not have the long residual effects that characterize many triazines. Weeds will emerge before dying.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. Maier-Bode, H. and K. Hartel (1981) Linuron and monolinuron. *Residue Reviews* 77: 1-352.
6. PP
7. HSDB

Propamocarb hydrochloride

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — propamocarb hydrochloride

[ii] TRADE NAME — *Tattoo C*, Previcur (AgrEvo Canada Inc.)

[iii] CHEMICAL NAME — propyl (3-(dimethylamino)propyl)carbamate monohydrochloride

[iv] CAS # - 25606-41-1

[v] TYPE / MODE OF ACTION — Systemic fungicide with protective action.

2. USE PATTERN

Provides specific control of phycomycetes in vegetables, ornamentals, and turf. Effective against *Phytophthora infestans* in potato and tomato. Combined with chorothalonil to control late blight in potatoes.

[i] APPLICATION — Applied by ground equipment only, before infestations develop. Applied as a foliar spray, soil application, or used in a seed/dip treatment.

[ii] RATES — 1.01 kg a.i./ha in 200-300 L water.[2]

CARRIER: Water.

[iii] FORMULATIONS

1. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Cannot be stored below freezing. Stable to hydrolysis, to temperatures up to 400°C and to photolysis.[1]

4. HANDLING PRECAUTIONS

Incompatible with alkaline materials.

5. ENVIRONMENTAL PERSISTENCE

Half-life in soil is 3-4 weeks due to microbial decomposition.[1]

[i] SOIL – Rapidly degraded in soil by microbial processes, following a brief lag phase. Propamocarb hydrochloride is retained in the upper soil layer (4-20 cm) and little is found in leachate. Stable in aqueous medium, but rapidly degraded by aquatic micro-organisms (up to 97% in 35 days). It is adsorbed onto sediment, but with limited desorption.[1]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	2000-8550 mg/kg		1
Rat	NOEL 2y	1000 mg/kg diet		1
Mouse	LD_{50} oral	1960-2800 mg/kg		1
Rabbit	LD_{50} dermal	>3920 mg/kg		1
Dog	LD_{50} oral	c. 1450 mg/kg		1
Dog	NOEL 2y	3000 mg/kg diet		1
Mallard	LD_{50} oral	>6290 mg/kg		1
Mallard	LC_{50} dietary 8d	12915 mg/kg diet		1
Pheasant	LD_{50} oral	3050 mg/kg		1
Trout	LC_{50} 96h	410-616 mg/L		1
Bluegill	LC_{50} 96h	415 mg/L		1
Carp	LC_{50} 96h	235 mg/L		1
Daphnia	*EC_{50} 48h*	*422 mg/L*		*1*

[i] TOXICITY (OTHER) – Not identified. Non-mutagenic.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Following oral administration in rats, total recovery in urine and faeces is c. 90% after 24 hours.[1] Rapidly absorbed and almost totally excreted, mainly via urine; mineralization occurs via oxidation and hydrolytic decomposition.[1]

[ii] PLANT – Mainly unchanged in plants.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM

Propiconazole

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — propiconazole (BSI, E-ISO, F-ISO)

[ii] TRADE NAME — Tilt, Banner (Syngenta Crop Protection Canada Inc.)

[iii] CHEMICAL NAME — (±)-1-[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-ylmethyl]-1*H*-1,2,4-triazole

[iv] CAS # — 60207-90-1

[v] TYPE / MODE OF ACTION — A sterol-inhibitor fungicide. This broad spectrum foliar fungicide has systemic and eradicative properties.

2. USE PATTERN

For the control of diseases caused by Ascomycetes, Basidiomycetes and Deuteromycetes[2] (Erysiphe graminis, Leptosphaeria nodorum, Puccinia spp., Pyrenophora teres, Rhynchosporium secalis, Septoria spp.).[1] In Eastern and Western Canada, this compound is used only on spring wheat, winter wheat, and spring barley.

[i] APPLICATION — Apply as a broadcast spray to the foliage and early ear stages of cereal crops. The timing of application is based on the stage of the crop and the level of disease development. One or two applications are usually required during the growing season for disease control. If rainfall occurs within two hours of application of propiconazole, reapplication is necessary. **Do not spray from aircraft.**

[ii] RATES — 50.0-125 g a.i./ha in 200-400 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

This product has a shelf life of 3 to 5 years when stored in a dry place, and minimum storage temperatures are observed.[2] Stable up to 320°C; no significant hydrolysis.[1]

4. HANDLING PRECAUTIONS

This pesticide is toxic to fish. Do not spray any body of water by direct application, drift, or by cleaning and rinsing spray equipment. Harmful if swallowed, inhaled, or absorbed through the skin. Do not contaminate food or feed. Do not feed straw from treated crops to livestock. Wear protective clothing when handling.

5. ENVIRONMENTAL PERSISTENCE

Propiconazole gives 3 to 6 weeks residual control.[3]

[i] SOIL – DT_{50} in aerobic soils (25°C) 40-70 days.[1]

[ii] AQUATIC – An estimated K_{oc} value of 1900 indicates that propiconazole has low mobility in soil. Volatilization from moist soil surfaces is not expected. This compound is expected to biodegrade in the environment with estimated half-lives of 40-70 days in aerobic soil and 25-85 days in aerobic water.[4]

[iii] ATMOSPHERIC – Propiconazole is expected to exist in both the vapor phase and particulate phase in the ambient atmosphere. Vapor-phase propiconazole is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals with an estimated atmospheric half-life of about 14 hours. Particulate-phase propiconazole may be physically removed from the air by wet and dry deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1517 mg/kg		1
Rat	LD_{50} dermal	>4000 mg/kg		1
Dog	NOEL	1.9 mg/kg b.w./d		1
Human	ADI	0.04 mg/kg b.w.		1
Rainbow trout	LC_{50} 96h	5.3 mg/L		1
Carp	LC_{50} 96h	6.8 mg/L		1
Crayfish	LC_{50} 96h	42.0 mg/L		1
Daphnia	*EC_{50} 48h*	*4.8-11.5 mg/L*		*1*

[i] TOXICITY (OTHER) — This compound is slightly irritant to the skin and eyes of rabbits. Non-sensitizing.[4] Toxic to fish. Non-toxic to bees; not expected to have any significant impact on other beneficial species under field conditions.[1] Non-mutagenic, non-teratogenic; no carcinogenic potential of relevance for human exposure.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – After oral administration to the rat, propiconazole is rapidly absorbed and also rapidly and almost completely eliminated with urine and faeces. Residues in tissues were generally low and there was no evidence for accumulation or retention of propiconazole or its metabolites.[1]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HSDB

Propoxur

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — propoxur (BSI, E-ISO, F-ISO, ESA); PHC (JMAF)

[ii] TRADE NAME — Baygon, Bay 39007, Blattanex, Suncide, Tugon Fliegenkugel, Unden, Bandit, Sendran, Cantol. Manufacturers include Bayer AG (W. Germany) and Mobay Chemical Corp.

[iii] CHEMICAL NAME — 2-isopropoxyphenyl methyl carbamate

[iv] CAS # — 114-26-1

[v] TYPE / MODE OF ACTION — A carbamate insecticide and acaricide with contact and stomach action.

[vi] NOTICE — **Registered commercially for mosquito control only. The active is under re-evaluation.**

2. USE PATTERN

Relatively broad spectrum insecticide for field crops, fruits and vegetables. Used to control aphids, lygus bugs, leafhoppers, thrips, and sawflies. Residual indoor application against mosquitoes, cockroaches, flies, etc. and against insect pests on ornamentals, flowers, lawns, and turf to control earwigs, crickets, ants, chinch bugs, spiders, etc. Characterized by fast knockdown and a long residual and flushing effect. Also used in treated wearing apparel.

[i] APPLICATION — Apply evenly and thoroughly and repeat as necessary. Bait formulations control crawling insects indoors and outdoors. Applied to turf for sod webworm and chinch bug control. Do not spray on orchards earlier than 3 weeks after petal fall.

[ii] RATES — 0.14-1.1 kg a.i./ha or at 0.5-2.0% concentrations for household spray. 9.4% concentration in flea collars.

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. EC
3. DU
4. SO
5. PP
6. SR

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Calculated: 0 m
3. Aerial application: Calculated: 0 m
4. Forestry application: Not identified.

3. STORAGE

Unstable in highly alkaline media.

4. HANDLING PRECAUTIONS

Use with water at <4.4°C or with oil causes crystallization in the spray tank. Do not use as a space spray. Do not apply to tidal marshes or estuaries. Spray immediately after mixing with alkaline materials. Do not use in fibreglass tanks.

5. ENVIRONMENTAL PERSISTENCE

Toxic at 10.0 µg/L to microbial organisms degrading organic matter in sewage; not detrimental to nitrification. Not metabolized.[5]

[i] SOIL — Propoxur is very mobile in soil.[7] Hydrolytic degradation predominates.[6] Low to moderate persistence in soil, reported half-lives of 14 to 50 days.[8]

[ii] AQUATIC – Hydrolyses in water at a rate of 1.5% per day in a 1% aqueous solution at pH 7.[8]

[iii] ATMOSPHERIC – If released to air propoxur will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase propoxur will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 12 hours. Particulate-phase propoxur will be removed from the atmosphere by wet and dry deposition.[9]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	80.0 mg/kg	Males	1
Rat	LD_{50} dermal	>500 mg/kg		2
Rat		250 mg/kg diet (12.5 mg/kg)	No effect level	6
Rat		750 mg/kg diet (50.0 mg/kg b.w.)	No effect level as evidenced by liver damage	6
Rat	NOEL 2y	200 mg/kg diet		1
Rat	2y F.T.	750 mg/kg diet	Liver wt. of female inc.; no other ill effects	3
Rabbit	Developmental study	>10.0 mg/kg/d	NOAEL for maternal toxicity, teratogenicity and fetotoxicity	7
Human	ADI	0.02 mg/kg b.w.		1
Red-winged blackbird		LD_{50} oral	2.0-6.0 mg/kg	3
Starling	LD_{50} oral	15.0-20.0 mg/kg		3
Rainbow trout	LC_{50} 96h	3.7-13.6 mg/L		1
Brook trout	EC_{50} 24h	3.0 mg/L	Considered highly unlikely that normal application rates would produce such concentrations	4
	LC_{50} 24h	6.0 mg/L	Considered highly unlikely that normal application rates would produce such concentrations	4
Landlocked salmon	LC_{50} 24h	11.2 mg/L		4
Daphnia	*EC_{50} 48h*	*0.15 mg/L*		*1*

[i] TOXICITY (OTHER) — Cholinesterase inhibitor; reversible depression of ChE activity evident a short time after exposure. Sensitivity of ChE sources differs in different animal species; erythrocyte ChE sensitivity is significantly higher than plasma ChE sensitivity in man, while in the rat brain and plasma ChE sensitivities similar. In man, acute signs of poisoning are rapidly reversible. Sensitivity to toxic effects decreases during prolonged exposure. Toxic to bees, fish, and birds. Non-irritating to skin, slightly irritating to eyes.[1] Rat teratogenicity and mutagenicity studies gave negative results. Long-term rat study showed no carcinogenic activity; reproduction not affected.

[ii] PHYTOTOXICITY — Non-phytotoxic when used as recommended. Some injury on chrysanthemums, carnations, and hydrangeas at higher rates. May cause blossom thinning on fruit trees.

7. METABOLISM

[i] ANIMAL – Breakdown in plants and animals follows a similar pathway. Some metabolites identified in rats, plants, and (*in vitro*) microsomes. Oxidative and hydrolytic degradation both occur; proceed to some degree in rats, but oxidation predominates in plants. Two main metabolites found in plants are 2-hydroxyphenyl-*N*-methyl carbamate and 2-isopropoxyphenyl-*N*-hydroxymethyl carbamate. The major metabolic pathway in mice involves depropylation to 2-hydroxyphenyl-*N*-methyl carbamate and hydrolysis of the carbamate to isopropoxyphenol.[7] In humans, 38% is excreted as phenols in the urine over 24 hours. Most is excreted in the first 8-10 hours. In rats, 64-72% is excreted in the urine, 47% in the faeces, and 26% is expired as CO_2 (after 48 hours). The residue level in the body is 4.2-7.9%.[7]

[ii] PLANT – The primary metabolite is demethyl propoxur.[1]

8. ADDITIONAL INFORMATION

Technical material contains minimally 95% propoxur. Impurities in technical materials are known. Believed compatible with most insecticides and fungicides in common use. Very effective against most public health pests. Has shown systemic activity when applied to soil.

9. REFERENCES

1. PM
2. FCH
3. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
4. Colquhoun, J.R. and H.J. Dean (1980) Toxicity of propoxur to brook trout and landlocked salmon. *N.Y. Fish and Game Journal* 27: 32-38.
5. Lieberman, M.T. and M. Alexander (1981) Effects of pesticides on decomposition of organic matter and nitrification in sewage. *Bull. Environ. Contam. Toxicol.* 26: 554-560.
6. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO meeting on pesticide residues. II. Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews* 63: 1-44.
7. (U.S.) Environmental Protection Agency Washington, DC Aug 88 Health Advisories for 50 Pesticides (Including Acifluorfen, Ametryn, Ammonium, Sulfamate Atrazine, Baygon, Bentazon, Bromacil, Butylate Carbaryl, Carboxin, Chloramben, Chlorothalonil Cyanazine, Dalapon, Dacthal, Diazinon, Dicamba 1, 3-Dichloropropene, Dieldrin, Dimethrin, Dinoseb, Diphenamid, Disulfoton, Diuron, Endothall Ethylene Thiourea, Fenamiphos, Fluometuron Fonofos, Glyphosate, Hexazinone, Maleic Hydrazine MCPA, Methomyl, Methyl Parathion, Metolachlor, Metribuzin, Paraquat, Picloram, Prometon Pronamid, Propachlor, Propazine, Propham, Simazine, 2,4,5-T, Tebuthiuron, Terbacil, Terbufos and Trifluralin).
8. PP
9. HSDB

Propyzamide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — propyzamide (BSI, E-ISO, F-ISO, JMAF); pronamide (WSSA)

[ii] TRADE NAME — Kerb (Rohm and Haas Co.)

[iii] CHEMICAL NAME — 3,5-dichloro-*N*-(1,1-dimethylpropynyl)benzamide

[iv] CAS # — 23950-58-5

[v] TYPE / MODE OF ACTION — Herbicide.

2. USE PATTERN

Used to control many broadleaf and grass weeds in crop plants, ornamentals, pasture, and rangeland. Controls quackgrass, blue grass, orchard grass, etc., along with common chickweed.[4] Perennial grasses can be suppressed at lower rates and controlled at higher rates in established alfalfa and birdsfoot trefoil.[4]

[i] APPLICATION — Conventional surface pre-emergence applications most effective when there is ample rainfall or irrigation. In dry environments shallow soil incorporation of 2.5-5.0 cm is beneficial. Should be applied in September or October with best results when soil temperatures are low and sufficient time is allowed for penetration into soil before ground freezes.[4] May be applied by air.[2]

[ii] RATES — Rates vary from 0.45-2.25 kg a.i./ha, depending on weed species, environmental conditions and the residual activity needed. Higher rates for control of mustard. 15.0 g a.i./100 m^2.

CARRIER: Water at 300-562 L/ha.

[iii] FORMULATIONS

1. WP

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 0 m
2.	Air blast application:	Calculated: 1 m
3.	Aerial application:	Calculated: 0 m
4.	Forestry application:	Not identified.

3. STORAGE

No decomposition in 2 year storage trail under normal conditions; storage at high temperature (>50°C) should be avoided.[5]

4. HANDLING PRECAUTIONS

Avoid skin contact. Do not breathe dust or spray mist. Do not contaminate food or feed. Do not permit drift to non-target areas. Do not use on high organic soils. A 3-12 month waiting period is required to follow with some crops. Store below 50°C. Should not be mixed with other types of pesticide but may be combined with certain other herbicides. If temperatures exceed 30-32°C it should be incorporated into the soil as soon as possible. Do not feed treated material to livestock.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Persists for 2-9 months depending on soil type and climatic conditions. If released to soil, pronamide undergoes transformation primarily by cyclization to yield 2-(3,5-dichlorophenyl)-4,4-dimethyl-5-methyleneoxazoline which is subsequently hydrolyzed. This cyclization appears to occur both chemically and microbially, although the transformation is significantly more rapid in the presence of soil microorganisms. Very little leaching will occur in most soil types although some leaching may occur in soils of very low organic content. Loss of pronamide from soil surfaces due to photodecomposition can occur; volatilization from soil surfaces under very hot and dry conditions has been observed. The resultant average persistence of pronamide when applied at recommended herbicidal rates is variable (2 to 9 months) and depends on soil type and climatic conditions.[5]

[ii] AQUATIC – If released to water, pronamide may be subject to chemical cyclization, biodegradation and direct photolysis. Volatilization from bodies of water is not likely to be significant with the possible exception of shallow rivers. Some partitioning from the water column to sediments may occur.[5]

[iii] ATMOSPHERIC – If released to the atmosphere in the vapor-phase, pronamide will react with photochemically produced hydroxyl radicals with an estimated half-life of 12 hours. Direct photolysis in the atmosphere may occur. Particulate-phase pronamide may be physically removed from air by wet and dry deposition.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD oral	8350 mg/kg	Males	1
Rat	LD^{50} oral	5620 mg/kg	Females	1
Rabbit	LD^{50} dermal	>3160 mg/kg		1
Dog	LD$^{50}_{50}$	>10000 mg/kg		1
Human	ADI	0.08 mg/kg		1
Japanese quail	LD oral	8770 mg/kg		1
Mallard	LD^{50} oral	>14.0 mg/kg		1
Rainbow trout	LC^{50} 96h	>4.7 mg a.i./L		1
Daphnia	*EC$^{60}_{50}$ 48h*	*>5.6 mg a.i./L*		*1*

[i] TOXICITY (OTHER) — Carcinogenic for liver of male mice.[3] WP formulation is mildly irritating to skin and eyes.

[ii] PHYTOTOXICITY — Injury may result from high rates of application on certain lettuce varieties. Do not use on dichondra, bluegrass, ryegrass, fescue, or bentgrass turf.[2]

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

Will not control dandelion, thistle, bindweed and most deep-rooted perennial weeds.[4] More effective in cool weather. More effective pre-emergence than post-emergence. Moisture is necessary after treatment.

9. REFERENCES

1. PM
2. AC
3. Reuber, M.D. (1980) Carcinogenicity of pronamide. *Environ. Res.* 23: 1 -12.
4. Ontario Ministry of Agriculture and Food (1981) *Guide to Chemical Weed Control.* 101 pp.
5. HSDB

Pyrazon

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — chloridazon (BSI, E-ISO); chloridazone (F-ISO); pyrazon (ANSI, WSSA, Canada, Denmark, Poland).

[ii] TRADE NAME — Pyramin, Pyramin FL, Chloridazon (BASF Canada Inc.)

[iii] CHEMICAL NAME — 5-amino-4-chloro-2-phenyl pyridazin-3 (2*H*)-pyridazinone

[iv] CAS # — 1698-60-8

[v] TYPE / MODE OF ACTION — A pyridazinone compound used as a selective pre-and post-emergence herbicide. Pyrazon causes inhibition of photosynthesis in target plants.[4] Conjugation to form *N*-glucosyl pyrazon in the beet plant is believed to be the basis for beet's tolerance.[4]

[vi] NOTICE — **Currently, only technical registered. No end-use products are registered for use in Canada.**

2. USE PATTERN

For weed control in sugar and table beets. Potential for damage in other crops exists. Effective against black nightshade, lambsquarters, mustards, ragweed, purslane, smartweed, pigweed, henbit, shepherd's purse, groundsel, dock, sporge, chickweed, wild radish, and others.[3] Incompatible with many pesticides but compatible with Thiallate and TCA.

[i] APPLICATION — Can be applied prior to crop emergence or post-emergence after the first true leaf of beet is 2.5 cm long. Do not apply when beets are in the cotyledon stage. 1.25 cm of irrigation is needed before germination and after application for good weed control.[3] Pre-emergence applications are not effective under furrow irrigation unless incorporated. Do not incorporate overall with a disc. Do not sprinkle irrigate if used as a soil-incorporation treatment. Do not apply under high temperatures or humidity or when beet foliage is wet.[3] Do not apply through injector-type applicators. Soil organic matter should be <5% or erratic weed control will result under dry conditions.[3]

[ii] RATES —3.5-4.4 kg a.i./ha

CARRIER: (PRE-EMERGENCE): 200-500 L water at a rate of 4.25 to 5.50 L/ha. (POST-EMERGENCE): oil/water emulsion or Citowett plus at 250 mL/100L water at a rate of 300-400 L/ha.

[iii] FORMULATIONS

1. WP
2. SG
3. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store in a cool, dry place. Non-corrosive and non-flammable.

4. HANDLING PRECAUTIONS

Do not breathe spray mist and avoid contact with eyes or skin. Do not contaminate food, feed, or water. Do not use on sands, loamy sands, muck, or peat soils. Drift on crops other than sugar beets or table beets will cause crop damage.

5. ENVIRONMENTAL PERSISTENCE

Four to eight weeks control, depending upon soil moisture and temperature.[3] Photodegradation is negligible.[4]

[i] SOIL — Persists in sandy loam for about 40 days and is decomposed to 5-amino-4-chloropyridazin-3(2*H*)-one, which is non-phytotoxic. Depending on soil temperature and moisture, microbial decomposition can reach moderately rapid rates.[4] Chloridazon is fairly resistant to leaching.[3]

[ii] AQUATIC – If released in water, Pyrazon may adsorb to sediment. It may undergo photolysis in surface water resulting in a half-life of < 1 month. Modeling studies predict an overall half-life in sediment/water systems of > 56 days.[6]

[iii] ATMOSPHERIC – If released in the atmosphere during spraying, Pyrazon would be removed by gravitational settling. Vapor-phase Pyrazon reacts with photochemically-produced hydroxyl radicals resulting in an estimated atmospheric half-life of 9.6 hours.[6]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	3030 mg/kg		2
Rat	2y F.T.	300 mg/kg diet	No detectable effect	4
Mouse	LD_{50} oral	3000 mg/kg		4
Rabbit	LD_{50} oral	1250 mg/kg		4
Dog	2y F.T.	1500 mg/kg diet	No noticeable effect	4
Human	ADI	0.16 mg/kg		1
Bobwhite quail	LD_{50} oral	>2000 mg/kg		1
Rainbow trout	LC_{50} 96h	32.0-46.0 mg/L		1
Bluegill sunfish	LC_{50} 96h	93.0 mg/L		1
Fathead minnow	LC_{50}	40.0 mg/L		
Daphnia	*EC_{50} 48h*	*131 mg/L*		*1*

[i] TOXICITY (OTHER) — Not harmful to wildlife under conditions of use. Non-toxic to shrimp.[5] May cause skin irritation. Non-toxic to bees.[1] Non-mutagenic,non-teratogenic and non-carcinogenic.[1]

[ii] PHYTOTOXICITY — Susceptible cash crops include cabbage, carrots, cucumbers, lima beans, and tomatoes. Beets are susceptible while in the cotyledon stage. Weeds lose much of their susceptibility by the time they have four true leaves.[3]

7. METABOLISM

[i] ANIMAL – In rats, following a single oral application, 85% is excreted in the urine within 1 hour, and 13% in the faeces. After repeated applications, excretion proceeds similarly with 75% in the urine and 15% in the faeces.[1]

[ii] PLANT – In beet, conjugation to form the *N*-glucosy; metabolite occurs.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HH
5. Vogt, G (1987) Monitoring of environmental pollutants such as pesticides in grown aquaculture by histological diagnosis. *Aquaculture* 67: 157-164.
6. HSDB

Pyrethrins

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — pyrethrins (BSI, E-ISO, ESA, JMAF); pyrethres (F-ISO)

[ii] TRADE NAME — Alfadex (Ciba-Geigy). Manufacturers include Fairfield American Corp., McLaughlin Gormley King Co., Penick Corp., and Prentiss Drug and Chemical Co.

[iii] CHEMICAL NAME – Not identified.

[iv] CAS # - 8003-34-7

[v] TYPE / MODE OF ACTION — Botanical insecticide and acaricide from *Pyrethrum cinerariaefolium* flower. Extract consists of pyrethrins I and II (chrysanthemic and pyrethroic acid esters), cinerins I and II (esters of cinerolone and chrysanthemic and pyrethroic acids), and jasmolin I and II (jasmoline and chrysanthemic and pyrethroic acids).

2. USE PATTERN

Powerful degradable contact insecticide producing rapid knockdown. Insecticidal activity markedly increased by addition of synergist (*e.g.*, piperonyl butoxide). Available in stock sprays, pet sprays, household sprays, aerosols, industrial sanitation sprays, etc. Effective on most insects although roaches seem somewhat resistant.

[i] APPLICATION — FOLIAGE: Apply evenly as often as necessary. No limitations on when it can be applied to crops. POST-HARVEST: Apply to grain as it is placed in storage. Also applied directly in space over stored commodities. Used as seed treatment. LIVESTOCK: Apply as mist or spray at rate of 57.0 g/animal the size of a cow. Can be applied liberally to swine. Repeat as necessary up to 2 x per day. Also used as dip. PREMISES: Surface spray to point of runoff or use aerosol, keeping room full of mist for 10 minutes. Widely used in greenhouses.

[ii] RATES — FIELD: 0.56 kg/ha. HOUSEHOLD: Aerosol at 0.6 g/28 m^3.

CARRIER: Solvent.

[iii] FORMULATIONS

1. Dusts (various a.i. content) on non-alkaline carriers; for concentrated aerosol (up to 20.0 g/L) the extract is dissolved in refined odourless kerosene, occasionally with dichloromethane, plus suitable propellants.
2. Synergists (usually piperonyl butoxide) and organophosphorus insecticides (especially diazinon) may be added to increase the kill.
3. Also PP.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Unstable in light. Rapidly hydrolyzed by acid or alkali with loss of insecticidal properties. Stable for long periods in water-base aerosols where emulsifiers give neutral water systems. Oxidized on exposure to air; stored flowers may lose 20% of their activity in a year. Oxidation can be inhibited with material such as hydroquinone, pyrogallol, tannic acid, isopropyl cresol, and other antioxidants. Impregnated and stabilized dusts are less susceptible than dusts of ground flowers. Stabilized oil concentrate is not oxidized.

4. HANDLING PRECAUTIONS

Avoid skin contact. Keep out of any body of water. Do not contaminate water by cleaning equipment or disposing of waste. Do not reuse empty container; destroy by perforating or crushing. Bury or discard in a safe place away from water supplies. Incompatible with lime and ordinary soaps, lead, copper, brass, zinc, or iron.

5. ENVIRONMENTAL PERSISTENCE

Rapidly broken down by sunlight with no residue problems. 50% or more of pyrethins applied to stored grain disappear in first 3-4 months of storage.[3]

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Pyrethrins are decomposed by exposure to light with loss of insecticidal activity. They also are rapidly oxidized and inactivated by air.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	2370 mg/kg	Males	1
Rat	LD_{50} oral	1030 mg/kg	Females	1
Rat	LD_{50} dermal	>1800 mg/kg		2
Mouse	LD_{50} oral	273-796 mg/kg		1
Human	ADI	0.04 mg/kg b.w.		1
Mallard	LD_{50} oral	>10000 mg/kg		1
Rainbow trout	LC_{50}	5.2 µg/L		1
Coho salmon	LC_{50} 96h	39.0 mg/L	Static tests	1
Channel catfish	LC_{50} 96h	114 mg/L	Static tests	1
Daphnia	EC_{50}	12.0 µg/L		1

[i] TOXICITY (OTHER) — No evidence that synergists increase toxicity. Low toxicity to warm-blooded animals, non-hazardous to apply and produces no harmful residue on food or crops. Highly toxic to fish and other cold-blooded animals. Some people develop an allergy. Non-teratogenic in rabbit.

[ii] PHYTOTOXICITY - Non-phytotoxic.

7. METABOLISM

[i] ANIMAL – In mammals, rapidly degraded in the stomach by hydrolysis of the ester bond to harmless metabolites.[1]

[ii] PLANT - Rapid metabolism by oxidation and hydrolysis. Apparent lack of tissue storage. Limited tests on metabolites indicate lower toxicity than parent compounds.[3]

8. ADDITIONAL INFORMATION

Relatively expensive. At least 80% of any remaining residues are removed by handling, processing, and cooking.[3]

9. REFERENCES

1. PM
2. FCH
3. Vettorazzi, G. (1977) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO expert committee on pesticide residues. III. Miscellaneous pesticides used in agriculture and public health. *Residue Reviews* 66: 137-184.
4. HSDB

Quintozene

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — quintozene (BSI, E-ISO, F-ISO); terrachlor (former exception, Turkey); PKhNB (USSR); PCNB (JMAF)

[ii] TRADE NAME — Terraclor, Quintozine (Crompton Co.)

[iii] CHEMICAL NAME — pentachloronitrobenzene

[iv] CAS # — 82-68-8

[v] TYPE / MODE OF ACTION — Chlorinated hydrocarbon compound used as a soil fungicide and seed disinfectant.

2. USE PATTERN

To prevent root rot, stem rot, black rot, storage rot, white mold, brown patch, bottom rot, and damping off in several plants and ornamentals. Mixed with fertilizer as a turf fungicide.

[i] APPLICATION — Applied to seed and surrounding soil at planting time as an in-furrow treatment. Apply broadcast or in a band. Pre-plant soil incorporation is very effective. Applied as a soil drench at time of transplanting, as a post-emergence spray, and as a seed treatment.[3]

[ii] RATES — 75% a.i./dip solution; 187.5-202.5 g a.i./100 L water; 63.8-937.5 g/100 m^2 in 15-40 L H_2O; 6.75 kg a.i./ha.

CARRIER: Water, other pesticides.

[iii] FORMULATIONS

1. DU
2. WP
3. Often formulated in combination with other pesticides.

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 20.6 m
2. Air blast application:	Calculated: (30.6) 21.2 m
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Non-corrosive. Stable to heat; stable in acidic media, hydrolysed by alkalis. Some surface coloring after 10 hours exposure to sunlight.[1] Store in cool, dry place.[4]

4. HANDLING PRECAUTIONS

Do not use treated seed for food or feed. Do not feed treated crop residue to livestock. Incompatible with alkaline materials.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — After 10 months, 80% of 5.0 mg of PCNB applied to 50.0 g of soil was lost. Persists in soil, with a half-life of approximately 4-10 months. Part is lost from the soil by volitisation.[1] Highly stable in soil, low volatility.[3] In an anaerobic soil, biodegradation proceeds rapidly.[4]

[ii] AQUATIC – In water, pentachloronitrobenzene should adsorb to suspended matter in the water column based on its K_{oc} values. Biodegradation of pentachloronitrobenzene under aerobic and anaerobic conditions is expected to be rapid in water with measured half-lives between 5 and 7 days. Pentachloronitrobenzene should volatilize from water surfaces. Estimated volatilization half-lives for a model river and model lake are 2 and 20 days, respectively, although volatilization rates may be attenuated due to adsorption of this compound to particulate matter in water.[4]

[iii] ATMOSPHERIC – If released to the atmosphere, pentachloronitrobenzene will exist in both the vapor and particulate phases. Vapor-phase pentachloronitrobenzene is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals with an estimated half-life of about 2200 days. Particulate phase pentachloronitrobenzene may be physically removed from the air, mainly by dry deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50}	>5000 mg/kg		1
Rat	LD_{50} oral	1700 mg/kg	Technical grade	2
Rat	NOEL 2y	1.0 mg/kg/d		1
Rabbit	LD_{50} dermal	>5000 mg/kg		1
Dog	NOEL 1y	3.75 mg/kg/d		1
Human	ADI	0.07 mg/kg b.w.		1
Mallard	LD_{50} oral	>2000 mg/kg		1
Rainbow trout	LC_{50} 96h	0.31 mg/L		1
Daphnia	*EC_{50} 48h*	*0.77 mg/L*		*1*

[i] TOXICITY (OTHER) – Non-irritating to skin; slightly irritating to eyes (rabbits).[1] LD_{50} (contact) >100μg/bee.[1]

[ii] PHYTOTOXICITY — Considered non-phytotoxic although slight marginal burning occurred on young lettuce. At excessive dosages, beans, beets, onions, and tomato seedlings have been injured as well.

7. METABOLISM

[i] ANIMAL – In mammals, the major routes of elimination are as unchanged material in the faeces or as metabolites in the urine.[1]

[ii] PLANT – Undergoes conversion to pentachloroaniline, methylthiopentachlorobenzene and a variety of chlorophenyl methyl sulfoxides and sulfones.[1]

8. ADDITIONAL INFORMATION

Low volatility. pH has little effect on the residual effectiveness. Does not cause off-flavour in root crops. Not effective against *Fusarium* and *Pythium* spp.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HSDB

Rimsulfuron

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — rimsulfuron (BSI, E-ISO, ANSI)

[ii] TRADE NAME — Elim, Ultim, Prism, Ultimax (DuPont Canada Inc.); Titus (Europe, Africa, Mediterranean: DuPont)

[iii] CHEMICAL NAME — 1-(4,6-dimethoxypyrimidin-2-yl)-3-(3-ethylsulfonyl-2-pyridylsulfonyl)urea

[iv] CAS # — 122931-48-0

[v] TYPE / MODE OF ACTION — Branched chain amino acid synthesis (ALS or AHAS) inhibitor. Selective systemic herbicide, absorbed by the foliage and roots, with rapid translocation to the meristematic tissues. Inhibits the plant enzyme acetolactate synthase, thereby blocking branched chain amino acid biosynthesis, hence stopping cell division and plant growth.[1]

2. USE PATTERN

Used in Eastern Canada on corn (not sweet or seed varieties), tomato, and potato crops. Rimsulfuron is a post-emergence sulfonylurea herbicide that effectively controls most annual and perennial grasses and several broadleaved weeds in maize.[1]

[i] APPLICATION — Do not apply by air. Avoid spray drift. Do not apply a foliar organophosphorus insecticide within 7 days before or after applying rimsulfuron. Apply with a recommended surfactant.

[ii] RATES — Corn, Potato, Tomato, 12.5-15.0 g a.i./ha.

CARRIER: Surfactant.

[iii] FORMULATIONS

1. WG

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Label: 10 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Reseal unused water soluble bags into outer bag when not in use. Keep water soluble bags away from excess moisture or physical damage during storage and prior to mixing in the spray tank. Do not reuse outer bag. Store product in original container only, away from other pesticides, fertilizer, food or feed. Not for use or storage in or around the home. Keep container closed.

4. HANDLING PRECAUTIONS

Apply only when the temperature in the 24 hours before and after application ranges between 5°C and 28°C. Rimsulfuron rapidly stops growth of susceptible species; typical symptoms usually appear within 5-7 days, but may not be noticeable for 2-3 weeks after application, depending on growing conditions and weed susceptibility. Rimsulfuron is a contact herbicide, and will not give residual control of grass or broadleaf weed seedlings that may germinate after application. Can be mixed with other herbicides. Rimsulfuron has a wide crop-safety margin under most conditions.[1] Must not be applied within 30 days of harvest. Do not graze the treated crop or cut for hay.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Degraded rapidly in soil, predominantly via chemical pathways (microbial degradation plays a minor role). Rates of degradation are influenced by pH, and the compound is most stable in neutral pH soil and degrades more rapidly in alkaline and acidic soils. DT_{50} in soil 10-20 days (25°C, lab study).[1]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg		1
Rat	LC_{50} inhalation 4h	>5.4 mg/l air		1
Rat	NOEL 2y	300 ppm	Male rats	1
Rat	NOEL 2y	3000 ppm	Female rats	1
Dog	NOEL 1y	50 ppm		1
Rainbow trout	LC_{50} 96h	>390 ppm		1
Bluegill	LC_{50} 96h	>390 ppm		1
Sheepshead minnow	LC_{50} 96h	>110 ppm		2
Blue-green algae	EC_{50} 5d	>29 ppb		2
Daphnia	EC_{50} 48h	>360 ppm		1

[i] TOXICITY (OTHER) —LD_{50} for bees (contact) >100µg/bee, (dietary) >1000 ppm.[1] Non-irritating to skin, moderately irritating to eyes (rabbits). Non-sensitizing to skin (guinea pigs).[1] Non-teratogenic, non-mutagenic or oncogenic.

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL - Rapidly metabolized and excreted in the urine and faeces.[1]

[ii] PLANT - Half-life in maize 6 hours, blackgrass 46 hours, Johnsongrass 25 days and *Sorghum bicolor* 52 days.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. ECOTOX

Rotenone

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The traditional name rotenone is accepted in lieu of common name (BSI, E-ISO, F-ISO, ESA); derris (JMAF)

[ii] TRADE NAME — Deritox (Scott's Canada Ltd.); Dri-Kill (Cooper Agropharm Inc.); Alox (C-I-L); Safer's Rotenone (Woodstream Canada Corporation); Gardo (Gardo Inc.); Later's Rotenone (Later Chemicals Ltd.); Pycrocide (McLaughlin Gormley King Co.); Noxall (Noxall Products Ltd.); Wilson's Rotenone (Wilson Laboratories Inc.).

[iii] CHEMICAL NAME — (2*R*,6a*S*,12a*S*)-1,2,6,6a,12,12a-hexahydro-2-isopropenyl-8,9-dimethoxychromeno [3,4-*b*] furo [2,3-*h*] chromen-6-one

[iv] CAS # — 83-79-4

[v] TYPE / MODE OF ACTION — Selective contact insecticide with some acaricidal properties. Root extract from certain *Derris* and *Lonchocarpus* spp.

2. USE PATTERN

Used as dust against garden insects, and lice and ticks on animals. Rotenone emulsions are used to eliminate or partially eradicate fish in water management (2-4 weeks prior to restocking). Used on ornamentals and crops.

[i] APPLICATION — FOLIAGE: Apply evenly at uniform rate; repeat as necessary. PREMISES: Apply as a space or surface spray. Used also in fogging machines for mosquito control or applied to pond water as a mosquito larvicide. DOGS and CATS: Dip, spray, dust, or back rub.

[ii] RATES — 0.56-2.2 kg a.i./ha; 1.5 mL a.i./ 3 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. DU
2. PP
3. SN
4. EC
5. WP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Not identified.
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Breaks down in storage. Readily oxidized, especially in the presence of light and alkali, to less insecticidal products. Readily racemised by alkali.

4. HANDLING PRECAUTIONS

Avoid skin contact. Keep out of any body of water. Do not contaminate water supply by cleaning equipment or waste disposal. Do not reuse empty containers; destroy by perforating and crushing, then bury or discard in a safe place away from water supplies. Deteriorates rapidly in sun, air, and water. Formulations lose effectiveness within a week after application; low persistence in dust or spray residues. Not compatible with alkaline substances.[1]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Rapidly broken down in soil; half-life is between 1 and 3 days. It does not readily leach from soil and is not expected to be a groundwater pollutant.[5]

[ii] AQUATIC — Light important in detoxifying surface water.[3] Breaks down rapidly in water. Exposure to sunlight results in loss of toxicity in 5 to 6 days of spring sunlight or 2 to 3 days of summer sunlight.[5]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD oral	132-1500 mg/kg		2
Mouse	LD^{50} oral	350 mg/kg		1
Rainbow trout	LC^{50}_{50} 96h	31.0 μg/L		1

[i] TOXICITY (OTHER) — Non-toxic to bees alone, but toxic in combination with pyrethrum.[1] Moderately toxic to most animals, very toxic to swine and fish. No harmful residues on vegetable crops. No harmful effects on pond macrobenthos at 0.5-2.0 mg/L.[4] Kills insects by inhibiting oxygen utilization in tissues. Very highly toxic to fish, used as a fish toxin (piscicide).[5] Reproductive effects seem unlikely in humans at expected exposures.[5]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – The principal metabolite is rotenonone.[1] Absorption in the stomach and intestines is relatively slow and incomplete, although fats and oils promote its uptake. The liver breaks down the compound fairly effectively. Studies suggest that approximately 20% of the applied oral dose (and probably most of the absorbed dose) may be eliminated from animal systems within 24 hours.[5]

[ii] PLANT – Highly active but short-lived photosensitizer; also sensitive to heat, mush of the rotenone is lost quickly at high temperatures.[5]

8. ADDITIONAL INFORMATION

Slow action. Incompatible with lime. Insects rarely become immune.

9. REFERENCES

1. PM
2. FCH
3. Engstrom-Heg, R. and R.T. Colesante (1979) Predicting rotenone degradation in lakes and ponds. *N.Y. Fish and Game Journal* 26: 22-36.
4. Houf, L.J. and R.S. Campbell (1977) Effects of antimycin A and rotenone on macrobenthos in ponds. U.S. Fish and Wildlife Service, Invest. Fish Control 80: 29 pp.
5. PP

Sethoxydim

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — sethoxydim (BSI, E-ISO); sethoxydime (F-ISO)

[ii] TRADE NAME — Poast (BASF Canada Inc).

[iii] CHEMICAL NAME — (±)-(*EZ*)-2-(1-ethoxyiminobutyl)-5-[2-(ethylthio)propyl]-3-hydroxycyclohex-2-enone.

[iv] CAS # — 74051-80-2

[v] TYPE / MODE OF ACTION — A post-emergence herbicide. Uptake is primarily through leaves. Once treated, susceptible grasses that were actively growing prior to treatment stop growing and undergo a burn-back and colour change first to a yellowish, then purplish, and finally a brown colour. Complete control does not occur for 7-21 days following treatment. Control of quackgrass develops more slowly than annual grasses. Sethoxydim kills actively growing rhizomes in quackgrass, as well as above ground vegetation. The regrowth of quackgrass is not significant until 6-8 weeks after treatment.

2. USE PATTERN

For the control of both annual grasses and quackgrass in flax, sugarbeets, dry common beans, tomatoes, onions (dry bulb), dry peas, potatoes, soybeans, and for control of annual grasses, wild oats, and volunteer cereals only in rapeseed (including canola) and snap common beans.

[i] APPLICATION — Apply when wild oats, foxtails, volunteer cereals, and other annual grasses are in the 1-6 leaf stage. Apply to quackgrass up to the 3 leaf stage. Crops are tolerant to sethoxydim at all stages of growth. May be applied by ground or air, as a broadcast or band treatment. Split applications may be used. Apply with non-phytotoxic crop oil concentrate. Do not apply if rainfall is expected within one hour. Effectiveness is decreased at tempeatures below 15°C, as well as at times of drought and flooding, as grasses are not actively growing.

[ii] RATES — 0.1-1.1 kg a.i./ha, 0.8-4.4 L/ha.

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: 1 m
3. Aerial application:	Calculated: 0 m
4. Forestry application:	Not identified.

3. STORAGE

Store in a cool, dry, ventilated place. Do not contaminate food or feed by storage or disposal. The commercial product is stable for at least 2 years under normal storage conditions.[1]

4. HANDLING PRECAUTIONS

Assist oil concentrate must be added to all applications of Poast. Wear gloves when handling products, and wash thoroughly after handling. Do not contaminate food or feed, any body of water, lake, stream, or pond. Do not apply where runoff or erosion is likely to occur. Rainfall within one hour of application may reduce effectiveness. Do not mix or apply Poast with any other additive, pesticide, or fertilizer, except as specifically recommended on label. Allow four days between application of Poast and any other chemical not recommended as a tank mix combination on the label. Allow a minimum of 14 days between application of Poast plus Assist and the replanting of cereals or grass crops. Do not graze or feed treated forage to livestock prior to crop maturity. Incompatible with organic and inorganic copper compounds.[1]

5. ENVIRONMENTAL PERSISTENCE

Sethoxydim has very little or no residual weed control.

[i] SOIL — Soil persistence is rather short and the magnitude depends on soil type, moisture, and possibly other environmental conditions. In loamy sand (pH 6.8) the half-life of sethoxydim was calculated to be 4-5 days. In a loam soil (pH 7.4) the half-life of sethoxydim was 11 days.[3] The degradation reached a "half-life" in approximately 25 days but root inhibition by 1.0 and 5.0 μg a.i./g of soil continued for about 150 and 280 days, respectively. This indicates the potential danger of cumulative effects of this herbicide and/or its breakdown products.[4] Sethoxydim could leach in soil.[6]

[ii] AQUATIC – Photodegradation of sethoxydim takes less than 1 hour. Poast is fairly stable to hydrolysis, with a half-life of about 40 days in a neutral solution at 25°C.[6]

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION — Sethoxydim exhibits noticeable control of perennials the season following application.[3]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*		*Ref.*
Rat	LD_{50} oral	3200-3500 mg/kg		2
Rat	LD_{50} dermal	>5000 mg/kg		1
Rat	NOEL 2y	17.2 mg/kg/d		1
Japanese quail	LD_{50} oral	>5000 mg/kg		1
Trout	LC_{50} 48h	38.0 mg/L	Technical grade	1
Rainbow trout	LC_{50} 96h	1.2 ppm		5
Daphnia	*EC_{50} 3h*	*1.5 mg/L*		*1*

[i] TOXICITY (OTHER) – Non-irritating to skin and eyes (rabbits); no skin sensitization.[1] No significant hazard to bees.[1] Practically non-toxic to bird; slightly toxic to aquatic species; low toxicity to wildlife; non-toxic to bees.[6] Non-mutagenic, non-carcinogenic. Reproductive effectts are unlikely in humans at expected exposure levels; unlikely to be teratogenic in humans at expected exposure levels.[6]

[ii] PHYTOTOXICITY – Non-phytotoxic to broad-leaved crops, but phytotoxic to most monocotyledonous crops (except onions, garlic and aspsragus).[1]

7. METABOLISM

[i] ANIMAL – In rats, following oral administration, 78.5% is eliminated in the urine and 20.1% in the faeces within 48 hours.[1]

[ii] PLANT – In soya beans, the parent molecule is oxidized, structurally rearranged, and conjugated. Transformation to metabolites is very rapid.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Roslycky, E.B., 1986. Microbial response to Sethoxydim and its degradation in soil. Can. J. Soil Sci. 66: 411-419.
5. ECOTOX
6. PP

Silicon dioxide 80%

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — Silicon dioxide 80%

[ii] TRADE NAME — Insectigone Insect Control Powder (Chemfree Environment Inc.); *Insectaway (Astral Tree Service).*

[iii] CHEMICAL NAME — Silicon dioxide

[iv] CAS # — 60676-86-0

[iv] TYPE / MODE OF ACTION — Insecticide which ruptures stomachs of pests upon ingestion.

2. USE PATTERN

Kills cockroaches, earwigs, ants, fleas, silverfish, crickets, millipedes, and centipedes indoors and outdoors.

[i] APPLICATION — Lightly coat the areas where these pests are found or may hide; cracks, crevices, behind appliances, cabinets, garbage cans, around pipes, drains, and basements. Dust carpets for flea control. Hit insects directly where possible.

[ii] RATES — Apply dust thoroughly wherever pests occur. Repeat treatment as necessary.

CARRIER: With attractants.

[iii] FORMULATION

1. WP
2. Flowable gel

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store in a cool, dry place out of reach of children and pets.

4. HANDLING PRECAUTIONS

Avoid breathing dust. Wear a dust mask.[1] Do not use as a space spray. Avoid contact with eyes.

5. ENVIRONMENTAL PERSISTENCE

Silicon dioxide is found naturally in the environment and is persistent but not harmful.

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

[i] TOXICITY (OTHER) – Moderate to low acute toxicity.[1] Moderately irritating to eyes and skin.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. USEPA. 1991. R.E.D. Facts: Silicon Dioxide and Silica Gel. Prevention, Pesticides and Toxic Substances. 738-F-91-107.

Simazine

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — simazine (BSI, E-ISO, F-ISO, ANSI, WSSA); CAT (JMAF)

[ii] TRADE NAME — Simadex (Aventis CropScience Canada); Princep (Syngenta Crop Protection Canada Inc.), Ekko (Ciba-Geigy Canada Ltd.); Terraklene (Zeneca Agro); *Amizine (Rhone-Poulenc Canada Inc.).* Other names include Gesatop and Primatol.

[iii] CHEMICAL NAME — 6-chloro-N^2,N^4-diethyl-1,3,5-triazine-2,4-diamine

[iv] CAS # — 122-34-9

[v] TYPE / MODE OF ACTION — A systemic triazine herbicide and algicide similar to atrazine. Absorbed through roots to inhibit photosynthesis. Does not prevent germination but destroys the seedling after entering the roots.[3]

2. USE PATTERN

Used selectively to control broadleaf and grass weeds in corn, citrus, deciduous fruits and nuts, olives, pineapple, established alfalfa and perennial grasses grown for seed or pasture, turf grasses grown for sod, ornamentals, nursery plantings, Christmas tree plantations, sugarcane, asparagus, and artichokes. It is also used as a vegetation control in non-cropland and can be added to water or aqueous systems for control of aquatic plants.

[i] APPLICATION — Application of either sprays or granules should be made on bare soil prior to weed emergence. It may also be applied prior to planting for many crops. Simazine has little or no foliar activity and must be absorbed by plant roots. Under dry conditions, a shallow incorporation may increase the degree of weed control. Granules are also used in citrus, fruit trees, and ornamentals.

[ii] RATES — 1.1-4.4 kg/ha for selective weed control; higher rates (5.6-44.4 kg/ha) for non-selective suspensions.[3] Use lower rates for sands, higher rates for peat and muck soils. Corn, 1.6-2.2 kg a.i./ha. Fruit crops, 2.2-4.4 kg a.i./ha in 300 L water. Shelterbelts, 4.4-6.6 kg a.i./ha in 550 L water.

CARRIER: Water at 225 L or more. Agitation is necessary to keep the chemical in suspension.

[iii] FORMULATIONS

1. WP
2. GR
3. EC
4. SN
5. SU
6. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Calculated: 0 m
3. Aerial application: Not identified.
4. Forestry application: Calculated: 0 m

3. STORAGE

Very stable over several years of shelf life and only slightly sensitive to natural light and extreme temperatures which would occur normally. Stable in neutral and slightly acidic or alkaline media. Rapdily hydrolysed by stronger acids and bases. Decomposed by ultraviolet irradiation.[1]

4. HANDLING PRECAUTIONS

None identified.

5. ENVIRONMENTAL PERSISTENCE

Simazine has long residual effects so do not plant another crop in the treated area in the same season, or in the fall, as injury may result.[3] A soil sterilant at high rates. The residual activity of simazine in soil at selective rates for specific soil types is such that many rotation crops can be planted one year after application. Simazine will persist longer under dry, cold conditions or conditions not conducive to maximum chemical and biological activity.

[i] SOIL — It will not leach readily and breaks down slowly in soil. Plant removal is a factor affecting the dissipation of Princep in soils. In a moist loam soil, simazine persistence when applied at a rate of 1.1-4.4 kg/ha was 3-6 months. Another source found that simazine applied at a rate of 2.2 kg/ha persisted for 17 months. Simazine applied at a rate of 4.5 kg/ha was found to degrade at a rate of 95% per year. Micro-organisms break simazine down in about one year.[3]

[ii] AQUATIC — Applied at a rate of 1.0 mg/L, simazine residue measures 0.012 mg/L after 456 days. Applied at 3.0 mg/L, there was an amount of 0.16 mg/L after 456 days in a small pond. In dewatered canals, residues of up to 0.249 mg/L were found after an application of 475 L/ha, after 4-6 months.

[iii] ATMOSPHERIC – If released to air simazine will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase simazine will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 22 hours. Particulate-phase simazine will be removed from the atmosphere by wet and dry deposition.[5]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg		1
Rat	NOEL 2y	10.0 mg/kg diet		1
Mouse	LD_{50} oral	>5000 mg/kg		1
Rabbit	LD_{50} dermal	>10200 mg/kg		1
Dog	NOEL 2y	20.0 mg/kg diet		1
Mallard	LC_{50} dietary 8d	51200 mg/kg		1
Bobwhite quail	LC_{50} dietary 5d	>5000 ppm		5
Hen	LD_{50} oral	>5000 mg/kg		1
Rainbow trout	LC_{50} 96h	>100 mg/L		1
Rainbow trout	LC_{50} 96h	25 mg/L		6
Bluegill sunfish	LC_{50} 96h	90.0 mg/L		1
Coho salmon	LC_{50} 96h	6.6 mg/L		5
Crucian carp	LC_{50} 96h	>100 mg/L		5
Fathead minnow	LC_{50} 96h	>100 mg/L		5
Stonefly	LC_{50} 96h	1.9 mg/L		5
Gammarus fasciatus	LC_{50} 96h	>100 mg/L		5
Daphnia	*EC_{50} 48h*	*>100 mg/L*		*1*

[i] TOXICITY (OTHER) — Non-irritating to eyes and skin in rabbits. No adverse effect on soil micro-organisms. Negligible toxicity to birds, wildlife, aquatic species and fish.[3] Non-toxic to bees (LD_{50} oral >99.0 ug/bee).[1] Reproductive effects are not likely in humans under normal circumstances; does not appear to be teratogenic, either non-mutagenic or weakly mutagenic.[7]

[ii] PHYTOTOXICITY — Mission variety of almonds may be injured. Grapes must be three years old before application is made. Sensitive crops include tomatoes, tobacco, oats, spinach, cucurbits, onions, clovers, carrots, beet, soybeans, crucifers, and lettuce.[3]

7. METABOLISM

[i] ANIMAL – In mammals, 65-97% of an oral dose is eliminated as a de-ethylated metabolite in 24 hours.[1]

[ii] PLANT - Readily metabolized in tolerant plants to hydroxysimazine and amino acid conjugates. Hydroxysimazine can be broken down further by dealkylation of side chains and by hydrolysis of resulting amino groups on the ring.[4]

8. ADDITIONAL INFORMATION

Water solubility is about 5.0 mg/L.

9. REFERENCES

1. PM
2. PMRA
3. AC
4. HH
5. HSDB
6. ECOTOX
7. PP

Sulfotep

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — sulfotep (BSI, E-ISO, F-ISO); sulfotepp (ESA)

[ii] TRADE NAME — Plantfume 103, *Plant Fog* (Plant Products Co. Ltd.)

[iii] CHEMICAL NAME — *0,0,0'*,0'-tetraethyl dithiopyrophosphate

[iv] CAS # — 3689-24-5

[v] TYPE / MODE OF ACTION — Organophosphorus insecticide and acaricide. Cholinesterase inhibitor.

[vi] NOTICE — Sulfotep has been **voluntarily discontinued** by its Canadian registrant. A single product, a greenhouse fumigant is registered for use until December 2004. Sale and distribution was prohibited as of December 31, 2001.

2. USE PATTERN

A non-systemic compound effective against a wide range of pests including aphids, spider mites, whiteflies, and thrips.[1] Used in greenhouse fumigation formulations[2] and on ornamentals.

[i] APPLICATION — Not identified.

[ii] RATES — 11.7 g a.i. in smoke; 1.75 mL/100m[3].

CARRIER: Not identified.

[ii] FORMULATIONS

1. DU
2. SN
3. GN

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Not identified.
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

Resistant to hydrolysis. Corrosive to iron.

4. HANDLING PRECAUTIONS

Wear appropriate clothing to prevent any possibility of skin contact. Wear eye protection to prevent any possibility of eye contact. Wear coveralls with long sleeves, tight collar and cuffs (wash every day). Employees should wash immediately when skin is wet or contaminated. Remove non-impervious clothing immediately if wet or contaminated.[4]

5. ENVIRONMENTAL PERSISTENCE

Brief persistence on foliage.

[i] SOIL – If released to soil, sulfotep is expected to have slight mobility. Volatilization from moist soil surfaces is expected to be an important fate process. However, adsorption to soil is expected to attenuate volatilization.[4]

[ii] AQUATIC – If released into water, sulfotep is expected to adsorb to suspended solids and sediment based upon the estimated K_{oc}. Volatilization from water surfaces is expected to be an important fate process. Estimated volatilization half-lives for a model river and model lake are 28 and 206 days, respectively. However, volatilization from water surfaces is expected to be attenuated by adsorption to suspended solids and sediment in the water column. An estimated BCF of 240 suggests the potential for bioconcentration in aquatic organisms is high. Hydrolysis is not expected to be an important environmental fate process since this compound only hydrolyzes in alkaline solutions.[4]

[iii] ATMOSPHERIC – If released to air sulfotep will exist solely as a vapor in the ambient atmosphere. Vapor-phase sulfotep will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 2 hours.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	c. 10.0 mg/kg		1
Rat	LD_{50} dermal 7d	65.0 mg/kg		1
Rat	LC_{50} inhalation 1h	0.33 mg/L air	Males	3
Rat	LC_{50} inhalation 1h	0.16 mg/L air	Females	3
Mouse	NOEL 2y	50.0 mg/kg diet		1
Dog	NOEL 13 week	0.5 mg/kg diet		1
Rainbow trout	LC_{50} 96h	3.61 μg/L		1
Daphnia	*EC_{50} 48h*	*2.0 μg/L*		*1*

[i] TOXICITY (OTHER) – Non-irritating to eyes and skin (rabbits).[1]

[ii] PHYTOTOXICITY – Phytotoxic to some ornamentals, *e.g.*, chrysanthemums, orchids, and some rose varities.[1]

7. METABOLISM

[i] ANIMAL – Orally administered sulfotep was absorbed relatively quickly by rats. Elimination took place quickly via the kidney.[1]

[ii] PLANT – Major metabolites are monothiotep, tetraethylpyrophosphate, diethylthiophosphoric acid and diethylphosphoric acid.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
4. HSDB

Sulphur

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The chemical names sulphur (E-ISO); soufre (F-ISO); sulfur (ESA, JMAF) are accepted in lieu of a common name.

[ii] TRADE NAME — Brimstone, Sulfron, Consul, Kolofog, Kolospray, Spersul, Thiovit, Microflotox, Sulsol, and Microfine sulphur

[iii] CHEMICAL NAME — sulphur

[iv] CAS # - 7704-34-9

[v] TYPE / MODE OF ACTION — Elemental sulphur is used as a non-systemic direct and protective fungicide and acaricide.

2. USE PATTERN

Effective for control of a variety of plant diseases, including brown rot of peaches, apple scab, peanut leafspot, rose mildew, powdery mildew, and rusts. Also used on fleahoppers and mites. Used on a large variety of crops.

[i] APPLICATION — Apply evenly and uniformly at specified intervals throughout the growing season. No time limit on when it may be applied.[1] May be applied by air.[1]

[ii] RATES — 56.0-196 kg a.i./ha; 5.0-8.0 g a.i./L water.[1]; 13.8 mL a.i./L water.

CARRIER: Water.

[iii] FORMULATIONS

1. Dusts up to 95%, wettable or dispersible 30-90%, 50% colloidal sulphur paste solutions, and microfine flowable aqueous suspensions
2. WP
3. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Bleaches certain articles and tarnishes metals. Smoking should be prohibited in storage areas.[3] Store in cool, dry, well-ventilated location, separate from flame and sparks, chlorates, nitrates, other oxidizing materials and hydrocarbons.[3]

4. HANDLING PRECAUTIONS

Do not apply at temperatures of 32°C. Do not combine with oil sprays or apply immediately before or after an oil spray. When used with arsenates, lime should be added as a safener. Safety goggles with side shields should be worn as well as heat resistant gloves and leather heat-resistant clothing. Avoid breathing vapors or dusts. Do not handle broken packages unless wearing appropriate personal protective equipment. If contact with the material is anticipated, wear appropriate chemical protective clothing. Contact lenses should not be worn when working with this chemical. Contaminated protective clothing should be segregated in such a manner so that there is no direct personal contact by personnel who handle, dispose, or clean the clothing.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – In the environment, slight oxidation to the volatile oxides.[2] When spilled onto soil, molten sulfur will solidify prior to any significant movement into the soil. In solid form, sulfur is insoluble and thus cannot be tansported downward to the ground water table. Traces of hydrogen sulfide represent the only aqueous phase contaminant likely to be detected.[3]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified

6. TOXICITY

[i] TOXICITY (OTHER) — Harmless to bees.[1] Relatively Non-toxic to mammals. May slightly irritate the skin and eyes. A very safe chemical.

[ii] PHYTOTOXICITY — Do not use on D'Anjou pears. Injury has been reported on apricots, raspberries, cucurbits, and certain other sulphur-shy plants. Use only on crops that are tolerant to sulphur or extreme injury may occur. Wettable sulphurs are the safest on tender foliage. Liable to cause injury at summer temperatures.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Degradation proceeds primarily by microbial reduction in and on plants.[2]

8. ADDITIONAL INFORMATION

Effectiveness of the material is based on the finely ground sulphur particles. Wettable powders, pastes, and flowable formulations contain particles 1-10 μm in size. Micronised sulphurs are 0.5-0.8 μm.

9. REFERENCES

1. AC
2. PM
3. HSDB

Tallow fatty acid amine ethoxylate

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — tallow fatty acid amine ethoxylate

[ii] TRADE NAME — Frigate Agricultural Surfactant (Zeneca Group Company); Relay (Syngenta Crop Protection Canada Inc.)

[iii] CHEMICAL NAME — tallow fatty acid amine ethoxylate

[iv] CAS # - Not identified.

[v] TYPE / MODE OF ACTION — Agricultural adjuvant, activator, and penetrant. Foliar absorption.

2. USE PATTERN

Tank mixed with Round-Up, Wrangler, or Laredo for improved seasonal control of quackgrasses (couchgrass, *Agropyron repens*) when using high spray volumes greater than 150 litres per hectare.

[i] APPLICATION — Quackgrass should be actively growing (3-4 leaf stage). For optimum control, quackgrass should have ample leaf area to absorb the spray, and should be at least 20 cm tall with rhizomes undisturbed by cultivation. Rainfall after spraying may wash off chemical and reduce effectiveness; dry conditions for six hours after treatment are essential.

[ii] RATES — 2.35 litres of Round-Up, Wrangler, or Laredo in at least 150 litres of water per hectare in combination with 0.5 % Frigate (0.5 litres per 100 litres of spray solution).

CARRIER: Water.

[iii] FORMULATIONS

1. SN

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: 0 m (**spray adjuvant for use with glyphosate only**)
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Store in the original containers, tightly closed, in a safe, dry place.

4. HANDLING PRECAUTIONS

Avoid contact with eyes or skin, and wear protective gloves and faceshield. Avoid contamination of water, food, or feed by storage or disposal. Do not contaminate ponds, waterways or ditches with chemical or used containers. Spray equipment should be washed thoroughly, particularly inside the top of the spray tank. Traces of the product can cause harm to susceptible crops sprayed later. Wear protective gloves and faceshield when handling the concentrate. Keep out of reach of children.[3]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – Not identified.

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1231 mg/kg		1
Rat	LD_{50} oral	620 mg/kg	Female	
Rabbit	LD_{50} dermal	10000 mg/kg		
Rasbora hetermorpha		*LC_{50} 48h*	*0.8 mg/L*	*2*
Rasbora hetermorpha		*LC_{50} 96h*	*0.7 mg/L*	*2*
Salmo trutta	*LC_{50} 48h*	*0.4-0.7 mg/L*		*2*
Salmo trutta	*LC_{50} 96h*	*0.4 mg/L*		*2*
Idus idus	*LC_{50} 48h*	*2.6-2.7 mg/L*		*2*
Idus idus	*LC_{50} 96h*	*2.3-2.5 mg/L*		*2*
Carassius auratus	*LC_{50} 48h*	*2.1 mg/L*		*2*

[i] TOXICITY (OTHER) – Not identified.

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. FCH
2. Verschueren, Karel. *Handbook of Environmental Data on Organic Chemicals*, 2nd Ed., Van Nostrand Reinhold Company, 1983.
3. PMRA. Frigate XL. Zeneca Agro.

Tebufenozide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — tebufenozide (BSI, pa E-ISO, ANSI)

[ii] TRADE NAME — Confirm, Mimic (Rohm & Haas Canada Inc., Dow Agrosciences)

[iii] CHEMICAL NAME — 3,5-dimethylbenzoic acid 1-(1,1-dimethylethyl)-2-(4-ethylbenzoyl)hydrazide.
[iv] CAS # — 112410-23-8

[v] TYPE / MODE OF ACTION — An ecdysone agonist insecticide. Lethally accelerates the molting process by binding to the ecdysone receptor protein.[1] Following ingestion, larvae stop feeding and undergo a lethal molt within 3-10 days.

[vi] NOTICE — Mimic is used primarily in the province of Newfoundland for the control of hemlock looper and budworm. The provincial government has established aquatic set backs for aerial applications. For forestry use, observed aquatic set back of 50m, and 100m for aerial applications in the proximity of salmon rivers.

2. USE PATTERN

Insecticide used to control lepidopteran larvae (caterpillars) on rice, fruit, row crops, nut crops, vegetables, vines and forestry.[1] Used for the control of eastern spruce budworm, jackpine budworm, hemlock looper and whitemarked tussock moth in forests and woodlands. Also used as an agricultural insecticide.

[i] APPLICATION — For forest management, apply by ground or aerial application for sites greater than 500ha. For woodlands management, aerial application for sites 500ha or less. Population monitoring may be done to determine whether application in subsequent years is necessary. For agricultural use, apply during early larval stages. Apply by airblast at a maximum wind speed of 11.2 kilometers per hour.

[ii] RATES — Uniform coverage of the foliage is essential to provide maximum protection from defoliation. FORESTRY and WOODLANDS: 70 g a.i./ha. A second application may be required to ensure adequate coverage. APPLES: 120-240 g a.i./ha in 1000 L/ha water. Rotate the application of Confirm 240F with other recommended insecticides. GREENHOUSE PEPPERS / TOMATOES / ORNAMENTALS: 120-144 g a.i./ha.

CARRIER: Water.

[iii] FORMULATIONS

1. DP
2. GR
3. SC
4. SU
5. WP

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Not identified.
2.	Air blast application:	Label: 15 m
3.	Aerial application:	Calculated: 0-350 m **(dependent upon block width and number of successive applications)**
4.	Forestry application:	Calculated: 0-350 m **(dependent upon block width and number of successive applications)**

3. STORAGE

Store in a cool, dry area. Do not store near water, food or feed. Do not contaminate water bodies, streams, lakes, ponds, by usage or disposal. Stable at 94°C for 7 days. Stable to light in pH 7 aqueous solution. Stable to dark, sterile water 30 days. DT_{50} in natural pond water 67 days, in light, 30 days.[1]

4. HANDLING PRECAUTIONS

May irritate eyes and skin. Wear protective clothing, impervious gloves and splash goggles during all mixing, loading and application and wash before re-use. Wear a cartridge respirator during application. Do not contaminate aquatic systems by cleaning of equipment or disposal of wastes. Do not apply when weather conditions favor drift or run-off from treated areas.

5. ENVIRONMENTAL PERSISTENCE

Considered stable. Tebufenozide has the potential to persist for over a year in both water and sediment, suggesting the potential for residue carryover into the next season in forest soil, forest litter and conifer needles. [4]

[i] SOIL — Moderately persistent to persistent in aerobic soils.[3] Potential exists for tebufenozide residue to persist into the next season in forest and agricultural soils.

[ii] AQUATIC — Solubility in water at 25°C, 0.83mg/L.[3] DT_{50} in natural pond water, in light, 30 days at 25°C.[1] The hydrolysis half-life of tebufenozide was 1034 days at pH 7, indicating that tebufenozide does not undergo appreciable hydrolytic degradation.[3]

[iii] ATMOSPHERIC – If released to air tebufenozide will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase tebufenozide will be removed from the atmosphere by wet and dry deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg		1
Mice	LD_{50} oral	>5000 mg/kg		1
Rat	NOEL 24months	5.5 mg/kg b.w.		1
Dog	NOEL 12months	1.9 mg/kg b.w.		1
Quail	LD_{50} oral	>2150 mg/kg		1
Rainbow trout	LC_{50} 96h	5.7 mg/L		1
Rainbow trout	LC_{50} 96h	4.58-6.59 ppm		2
Bluegill	LC_{50} 96h	3.0 mg/L		1
Mysid Shrimp	LC_{50} 96h	1.4 mg/L		1
Daphnia	*EC_{50} 48h*	*3.8 mg/L*		*1*

[i] TOXICITY (OTHER) — In animals, toxicity to skin and eyes is relatively low. Not a skin sensitizer (guinea pig).[1] LD_{50} 96 hours honeybees is >234 mg/bee.[1] Safe to predatory mites, beetles and wasps. Some products are toxic to certain non-target invertebrates. The log octanol/water partition coefficient for tebufenozide is 4.23, indicating a high potential for bioaccumulation.[3] Non-mutagenic.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – In the rat, 16 whole-molecule metabolites are formed as a result of oxidation of the alkyl substituents of the aromatic rings, primarily at the benzylic positions.[4]

[ii] PLANT – In apples, grapes, rice, and sugar beet, the major component is unchanged tebufenozide. Metabolites which are detected in small amounts result from oxidation of the alkyl substituents of the aromatic ring, primarily at the benzylic position.[4]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. ECOTOX
3. Pest Management Regulatory Agency. February 16, 1996. Proposed Regulatory Decision Document PRDD96-01. Tebufenozide.
4. Sundaram, K.M.S. 1997. Persistence of tebufenozide in aquatic ecosystems under laboratory and field conditions. *Pesticide Science*. 51:7-20.
5. HSDB

Terbacil

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — terbacil (BSI, E-ISO, F-ISO, ANSI, WSSA, JMAF)

[ii] TRADE NAME — Sinbar (E.I. duPont de Nemours and Co., Inc., Biochemical Dept.)

[iii] CHEMICAL NAME — 3-*tert*-butyl-5-chloro-6-methyluracil

[iv] CAS # — 5902-51-2

[v] TYPE / MODE OF ACTION — An odourless, white crystalline solid with herbicidal action. Terbacil inhibits photosynthesis and is absorbed by plant roots.

[vi] NOTICE — In January of 2002, U.S. EPA revoked certain residue tolerances for terbacil due to the cancellation of food usage for terbacil containing products.

2. USE PATTERN

Used to control many annual and some perennial weeds, in crops such as apples, blueberries, peaches, citrus, alfalfa, mint, sugarcane, pecans, and strawberries.

[i] APPLICATION — It is sprayed on soil surfaces just before or during period of active growth of weeds. Tops should be removed from dense growth before application. Applications on sugarcane and mint can be made by aircraft. Rainfall or sprinkler irrigation is required following application to move this material into the weed germination zone.[3]

[ii] RATES — 0.9-3.6 kg/ha on johnson grass seedlings and most annual broadleaf and grass weeds. 3.6-9.0 kg/ha required to control bermuda grass, quackgrass, yellow nutsedge, horsenettle, and sheep sorrel; repeat application may be necessary. 0.44-1.3 kg/ha to control weed seedlings in alfalfa. Partial control of perennial weeds such as purple nutsedge, paragrass, and torpedograss accompanies treatment at maximum doses. Total vegetation control at 11.2-22.4 kg a.i./ha.

CARRIER: Water in volumes to cover area treated sufficiently. 56-112 L/ha for air equipment and at least 450 L/ha for ground equipment. Continuous agitation needed to maintain suspension.

[iii] FORMULATIONS

1. WP

[IV] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 20 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Active ingredient is chemically stable under normal storage conditions. Non-flammable and non-corrosive. Stable up to its melting point and in water and aqueous alkali at room temperature.[1] Store in a cool dry place.

4. HANDLING PRECAUTIONS

Not to be used on sandy soils or soils with less than 1% organic matter. Non-tolerant plants should not be planted in treated area for two years. Apply to trees that have been established at least 2-3 years. Water solubility is 710 mg/L. Avoid contact with eyes, skin, and clothing. Avoid breathing spray mist.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Terbacil is comparable to bromacil in having a relatively low tendency to be absorbed on soil colloids. The amount of terbacil absorbed on keyport silt loam soil in equilibrium with 1.0 mg/kg in soil solutions is 1.7 mg/kg compared with 1.5 mg/kg of bromacil, 2.6 mg/kg of monuron, and 40.0 mg/kg of diuron. The half-life was determined to be approximately 5-6 months when applied to the surface of a silt loam soil. Undergoes microbial decomposition in moist soil; highly persistent, 50% still remains 5-7 months after applying 4.5 kg/ha.[1]

[ii] AQUATIC – Stable in water and does not readily undergo hydrolysis or photodegradation. Terbacil's high water solubility and mobility in soil allow it to contaminate near-by surface waters.[7]

[iii] ATMOSPHERIC – If released to air terbacil will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase terbacil will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 51 days. Particulate-phase terbacil will be removed from the atmosphere by wet and dry deposition. Terbacil absorbs light in the environmental UV spectrum and has the potential for direct photolysis.[8]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	>5000 mg/kg		2
Rat	NOEL 2y	250 mg/kg diet		1
Dog	NOEL 2y	250 mg/kg diet		1
Pheasant	LC$_{50}$ dietary 8d	>31450 mg/kg diet	Chicks	1
Pekin duck	LC$_{50}$ dietary 8d	>56000 mg/kg diet	Ducklings	1
Rainbow trout	LC$_{50}$ 96h	39.7 ppm		6
Pumpkinseed Sunfish	LC$_{50}$ 48h	86.0 mg/L		1
Fiddler crab	LC$_{50}$ 48h	>1000 mg/L		1
Daphnia	*EC$_{50}$ 48h*	*68.0 ppm*		*1*

[i] TOXICITY (OTHER) — May irritate eyes, nose, throat, and skin. Not a skin sensitizer.[1] Testing on *Drosophila melanogaster* has shown this chemical to be non-mutagenic. No sex-linked recessive lethal mutation was found, and no increase in sister chromatid exchange in cells. Non-toxic to bees.[1] Slightly toxic to birds, non-toxic to aquatic organisms.[7] Terbacil is not considered to present a genotoxic hazard for those people involved either in its production or its use.[4] Adverse effects on reproduction in humans are not likely at expected exposure levels[7] Non-mutagenic; dooes not appear to be carcinogenic.[7]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – In alfalfa, 12% of terbacil plus its mmetabolites are still found 6-8 months after application.[1]

8. ADDITIONAL INFORMATION

Control expected for 2-4 months and longer for johnsongrass. Some inhibition of soil nitrification at normal field rates, but high concentrations are needed to produce 50% inhibition.[5]

9. REFERENCES

1. PM
2. FCH
3. AC
4. Boerzsoenyi, M., Z. Kocsis, A. Pinter, M. Csik, Z. Kelecsenyi, A. Surjan and G. Toeroek (1987) Mutagenicity studies on terbacil, a uracil-analogue pesticide. *Acta Morphol.* (Hung.), Vol 35: 3-8.
5. Ratnayatke, M. and L.J. Andus (1978) Studies on the effects of herbicides on soil nitrification, II. *Pestic. Biochem. Physiol.* 8: 170-185.
6. ECOTOX
7. PP
8. HSDB

Terbufos

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — terbufos (BSI, E-ISO, F-ISO, ANSI, ESA)

[ii] TRADE NAME — Counter (BASF Canada), *Cygard (Cyanamid Canada Inc.)*

[iii] CHEMICAL NAME — *S-tert*-butylthiomethyl *0,0*-diethyl phosphorodithioate

[iv] CAS # — 13071-79-9

[v] TYPE / MODE OF ACTION — An organic phosphate insecticide and nematicide.

[vi] NOTICE — The **PMRA has proposed that uses of terbufos on canola and mustard be phased out by the end of June 2004**, as alternatives exist. **Uses on corn and rutabagas are to be phased out by the end of 2004**. As no registered alternatives to terbufos exist for control of wireworm in sugar beets, the **PMRA has proposed to continue to accept terbufos registration for this use pattern only until December 31, 2006**.

2. USE PATTERN

For control of corn rootworm, soil insects, and nematodes infesting corn. Also controls sugarbeet maggots, greenbugs on grain sorghum, black maize beetles [4], and white grubs [6] in maize.

[i] APPLICATION — Applied to the soil at planting time either in a band, or directly to the seed furrow.

[ii] RATES — 2.75-5.5 kg a.i./ha; 6.75-11.25 g a.i./100 m.

CARRIER: Not identified.

[iii] FORMULATIONS

1. GR

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Calculated: 24-32 m
2.	Air blast application:	Not identified.
3.	Aerial application:	Not identified.
4.	Forestry application:	Not identified.

3. STORAGE

When stored at room temperature this product is stable for 2 years. Decomposes on prolonged heating above 120°C.[1]

4. HANDLING PRECAUTIONS

May be fatal if swallowed, inhaled, or absorbed through the skin. Repeated inhalation or skin contact may, without symptoms, progressively increase susceptibility to poisoning. Do not contaminate food or feed products. Not for use or storage in or around the home.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — The half-life of terbufos in silt loam soil appears to be about 15 days. The half-life of its residues is 22 days. The total residue concentration in soil after 106 days is less than 1.0 mg/kg. The half-life in sandy loam soil is much smaller. Terbufos is relatively immobile in soil under leaching and non-leaching conditions[5] and is not expected to leach into groundwater.[3] Oxidative and hydrolytic degradation occurs in soil. No accumulation.[1]

[ii] AQUATIC – Hydrolyzes rapidly.[9]

[iii] ATMOSPHERIC - Terbufos is expected to degrade in the ambient atmosphere by reaction with photochemically produced hydroxyl radicals with a half-life of 0.004 day.[10]

[iv] PHYTODEGRADATION — Residue testing of marketable broccoli, cabbage, and cauliflower showed that after 57 days there were 0.43 mg/kg total residues in the plant, but only traces (<0.01 mg/kg, fresh wt.) in the marketable heads harvested 90 days after seeding.[7]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	4.5 mg/kg	Male	2
Mouse	LD_{50} oral	5.4 mg/kg	Female albino mice	1
Rabbit	LD_{50} dermal	1.0 mg/kg		1
Rat	LD_{50} dermal	9.8 mg/kg		1
Rat	Contact 24h	27.5 mg a.i./kg	As 10% G.R.	8
Rat	Contact 24h	>200 mg a.i./kg	As 2% G.R.	8
Rat	NOEL 2y F.T.	1.0 mg/kg diet	No adverse effects other than ChE depression	1
Mallard	LC_{50} dietary 8d	185 mg/kg diet.		1
Pheasant	LC_{50} dietary 8d	145 mg/kg diet		1
Bluegill sunfish	LC_{50} 96h	0.004 mg/L		1
Rainbow trout	LC_{50} 96h	0.01 mg/L		1
Honeybee	LD_{50} topical	0.0041 mg/bee		1
Daphnia magna	*LC_{50}*	*0.31 µg/L*	*Very highly toxic*	*3*

[i] TOXICITY (OTHER) — Toxic to fish, aquatic invertebrates, birds and wildlife. Non-toxic to bees when used as directed.[1] Toxic to humans. Acute cholinesterase inhibition has been noted in all acute toxicity studies.[3] The metabolites of terbufos (terbufos sulphoxide and terbufos sulphone) are also extremely toxic.[5] Skin and eye irritant.[1] Unlikely to cause reproductive effects in humans; non-mutagenic, non-carcinogenic.[9]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL – Degradation in animals is the same as in soil.[1] Terbufos and its metabolites do not accumulate in the tissue.[9]

[ii] PLANT – Degradation in plants is the same as in soil.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. U.S. Environmental Protection Agency. Pesticide Fact Handbook. Noyes Data Corporation, 1988. 827 pp.
4. Drinkwater, T.W (1987) The efficacy of insecticides in the control of the black maize beetle, *Heteronychus arator* (Col: Scarabaeidae) in maize in South Africa. *Phytophylactic* Vol. 19: 275-277.
5. Felsot, A., L. Wei and J. Wilson (1982) Environmental chemodynamic studies with terbufos (Counter® insecticide in soil under laboratory and field conditions. *J. Environ. Sci. Health.* B17: 649-673.
6. Gough, N. and J. D. Brown (1988) Insecticidal control of white grubs (Coleoptera: Scarabaeidae) on the Atherton Tableland, with observations of crop losses. Queensl, *J. Agric. Anim. Sci.* 45: 9-17.
7. Szeto, S.Y., *et al.* (1986) Degradation of terbufos in soil and its translocation into cole crops. *J. Agric. Food Chem.* 34: 876-879.
8. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
9. PP
10. HSDB

Thiabendazole

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — thiabendazole (BSI, E-ISO, F-ISO, BAN, JMAF)

[ii] TRADE NAME — Mertect, Arbotect 20-S (Syngenta Crop Protection Canada Inc.); Metasol TK-100 (Calgon Canada Inc.). Other names include Shield-brite S-350 (Shield-brite Corporation); Brite X 545F (Brogde X Company); *Apron T (Ciba-Geigy Canada Ltd.)*; Apl-lustr 256 (Pennwatt Corp. USA).

[iii] CHEMICAL NAME — 2-(4-thiazolyl)-1*H*-benzimidazole

[iv] CAS # — 148-79-8

[v] TYPE / MODE OF ACTION — Systemic fungicide. A benzimidazole compound with protective and curative action. Also used as an anthelmintic (TBZ, thibenzole) in human and veterinary medicine.

2. USE PATTERN

Eradicant and protective fungicide on many crops including asparagus, avocado, banana, cabbage, celery, cherry, citrus, cucurbits, grapes, mushrooms, onions, ornamentals, pome fruit, potatoes, rice, soybeans, sugarbeets, sweet potato, tobacco, tomatoes, turf, and wheat. Pathogens controlled include species of *Aspergillus, Botrytis, Ceratocystis, Cercospora, Collectotrichum, Diaporthe, Fusarium, Giberella, Gloesporium, Oospera, Penicillium, Phoma, Rhizoctonia, Sclerotinia, Septoria,*and *Verticillium.* Not effective against *Phyophthora, Pythium,* or *Rhizopus.* Used to control storage rot in potato. Anthelmintic against nematodes in cattle, sheep, goats, swine, and humans. Used as a preventative and therapeutic treatment for Dutch Elm disease.[4]

[i] APPLICATION — One to two applications per season; late flowering to early pod set and then 2 weeks later. May be applied by air.

[ii] RATES — Potato, 3.6 kg a.i./ 8 L water. Apple, pear, 0.23 kg a.i./ 500 L water. Elm, inject 6.0-24.0 mL a.i./ 13 cm diameter of tree for a one year treatment.[4]

CARRIER: Water.

[iii] FORMULATIONS

1. SN
2. DU
3. SU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable under normal conditions to hydrolysis, light, and heat. Thiabendazole tablets should be stored in tight containers. Readily sublimes when heated. Store above 0°C. Do not dilute in highly alkaline waters.

4. HANDLING PRECAUTIONS

Do not apply within 21 days of harvest. Do not graze or feed treated soybean vines or hay to livestock. Avoid foaming. Discard the solution when it becomes dirty, if used >5 times, or after 24 hours. Do not tank mix with copper fungicides. Compatible with a number of other pesticides.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Expected mobility of thiabendazole is low to slight. Half-life is ~400 days.[5]

[ii] AQUATIC — If released to water, thiabendazole will be essentially non-volatile. Biodegradation is not expected to be an important fate process. Bioconcentration is not expected to be significant although adsorption to sediment may occur.[5]

[iii] ATMOSPHERIC - If released to air thiabendazole will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase thiabendazole will be removed from the atmosphere by wet and dry deposition.[5]

[iv] PHYTODEGRADATION — High stability on and in fruit and, under conditions of use, no metabolites or degradation products are likely to occur.[6]

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	3100 mg/kg		2
Rat	NOEL 2y	40.0 mg/kg/d	No ill effects	1
Mouse	LD_{50} oral	3600 mg/kg		1
Mouse	5 generation reproduction	200 μl/L	No adverse effects	6
Mouse	NOEL	30.0 mg/kg/d		6
Rabbit	LD_{50} oral	3850 mg/kg		1
Dog	NOEL	20.0 mg/kg/d		6

[i] TOXICITY (OTHER) — Not toxic to bees. No observable clinical effect followed chronic inhalation at 70 mg/m^3. Not hazardous to wildlife.[3] Retarded growth a common effect in animals at high doses.[6] Non-irritating to eyes and skin (rabbits). Not a skin sensitizer (guinea pigs).[1] Reproductive effects in humans are not likely from thiabendazole exposure. Non-mutagenic, Teratognic effects are not likely from thiabendazole exposure, it does not appear that thaibendazole is carcinogenic.[7]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL – Use as an anthelmintic gives rise to low-level transient residues in several edible tissues, but these are eliminated within 3 days. Lactating dairy animals receiving therapeutic dose secrete detectable amounts in milk for 24 hours after treatment.[6] Rapidly absorbed from gut; excretion in urine and faeces complete within 3-8 days.[6] Metabolites include 5-hydroxythiabendazole, in both free form and conjugated as a glucuronide and sulphate ester.

[ii] PLANT – The residue on all crops treated pre- or post-harvest is parent thiabendazole.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. PMRA
5. HSDB
6. Vettorazzi, G. (1977) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO Expert Committee on Pesticide Residues. III Miscellaneous pesticides used in agriculture and public health. *Residue Reviews*, 66: 137-184.
7. PP

Thifensulfuron methyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — thifensulfuron methyl

[ii] TRADE NAME — Refine Herbicide Dry Flowable, Freedom, Extra (Dupont Canada Inc.)

[iii] CHEMICAL NAME — methyl-3-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino] carbonyl] amino] sulfonyl]-2-thiophenecarboxylate.

[iv] CAS # — 79277-27-3

[v] TYPE / MODE OF ACTION — A selective post-emergent herbicide.

2. USE PATTERN

For control of broadleaf weeds in wheat (spring, winter, or durum), barley, and oats not underseeded to legumes and grasses. Controls growth of chickweed, hemp-nettle, lady's thumb, redroot pigweed, russian thistle, green smartweed, stinkweed, lamb's-quarters, corn spurry, volunteer rapeseed, cow cockle, wild buckwheat, and wild mustard. Will suppress growth of Kochia.[2]

[i] APPLICATION — Apply to young, emergent, actively growing weeds before the canopy closes. Weeds should be less than 10 cm tall and across. Weeds that emerge after treatment are not controlled. Weeds hardened off by environmental stress may not be adequately controlled or suppressed and regrowth may occur. Must be applied with a recommended surfactant such as (1) Agsurf, (2) Agral 90, or (3) Citowett Plus at a rate of 2.0 litres per 1000 litres spray solution, when crop is in the two leaf to flag leaf (shotblade) stage of growth. Discolouration of dying weeds may not be noticeable for 1 to 3 weeks after application. Control may be reduced if precipitation occurs soon after application.[2]

[ii] RATES — 20.0 g Refine/ha with recommended surfactant.

CARRIER: Water at minimum spray volume of 100 L/ha. Continous agitation required.[2]

[iii] FORMULATIONS

1. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 0 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Store product in original container only, away from other pesticides, fertilizer, food, or feed. Not for use or storage in or around the home.[2] Stable at 55°C.[1]

4. HANDLING PRECAUTIONS

Keep out of reach of children. Avoid breathing spray mist. Avoid contact with skin, eyes, and clothing. Do not apply to wheat, barley, or oats that are stressed by severe weather conditions, frost, low fertility, drought, water saturated soil, disease, or insect damage as crop injury may result. Do not apply to irrigated land where tail water will be used to irrigate crop land. Do not graze or feed treated forage to livestock within 7 days of application (this does not apply to air applications). Do not apply near desirable trees or plants or on areas into which their roots may extend.[2]

5. ENVIRONMENTAL PERSISTENCE

Thifensulfuron methyl is a short residual herbicide due to its susceptibility to microbial breakdown in soil. Treated areas may be replanted as soon as 45 days subsequent to treatment. Persistence studies in greenhouse-grown soybeans revealed thifensulfuron methyl half-lives ranged from 5 to 20 days in foliage. This decline was attributed to metabolic degradation and growth dilution.[2]

[i] SOIL – Broken down in soil to non-active metabolites by microbial degradation and chemical hydrolysis.[1]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>5000 mg/kg		1
Rat	NOEL 90d	100 mg/kg diet		1
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Mallard	LD_{50} oral	>2510 mg/kg		1
Rainbow trout	LC_{50} 96h	>100 mg/L		1
Daphnia	*EC_{50} 48h*	*970 mg/L*		*1*

[i] TOXICITY (OTHER) – Non-irritating to skine; mild but reversible irritant to eyes. Not a skin sensitizer.[1] Non-toxic to bees.[1] Non-mutagenic.[1]

[ii] PHYTOTOXICITY – Treated cereals may experience a temporary inhibition of growth and colour changes in the leaves, but these have no ultimate effect on the yield.[1]

7. METABOLISM

[i] ANIMAL – In mammals, following oral administration, 70-75% of the unchanged material is excreted in the urine and faeces.[1]

[ii] PLANT – Complete degradation occurs within a few days.[1]

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. Brown, H.M.. L.B. Brattsen, D.E. Lilly, and P.J. Hanna (1993). Metabolic pathways and residue levels of Thifensulfuron Methyl in soybeans, *J.Agric. Food Chem.* 41: 1724-1730.

Thiophanate-methyl

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — thiophanate-methyl (BSI, E-ISO, F-ISO, ANSI, JMAF)

[ii] TRADE NAME — Easeout (Novartis Crop Protection); Proturf (Nu-Gro IP Inc.); Senator (Engage Agro Corporation); *DCT (Norac Concepts Inc.)*

[iii] CHEMICAL NAME — dimethyl 4,4'-(*o*-phenylene)bis(3-thioallophanate)

[iv] CAS # — 23564-05-8

[v] TYPE / MODE OF ACTION — Curative and preventative systemic fungicide (benzimidazole group).

2. USE PATTERN

Effective against certain diseases of apples, pears, lowbush blueberries, peaches, nectarines, plums, prunes, strawberries, and white beans. Controls *Pythium* spp., smut, powdery mildew, anthracnose, dollar spot, grey mould, brown patch, *Botrytis*, *Cercospora*, black spot, *Fusarium* spp., *Penicillium* rots, stem rot, bacterial diseases, *Sclerotinia* rot, apple scab, brown rot, downy mildew, post-harvest decay, etc. Broad spectrum of plant disease control. Some mite control observed. Prevents ozone damage to plants.[2]

[i] APPLICATION — Soil drench, seed treatment, or post-harvest dip on fruits (max. 2 minutes). Apply before disease appears; repeat as necessary, usually at 10-14 day intervals. Spray with ground equipment using sufficient volume for thorough coverage. May be applied by air. Also used as a potato seed piece treatment.[2] Often used in a tank mix with a suitable protectant fungicide such as captan.

[ii] RATES — Apple, pear, 0.44 kg a.i./ha. Peaches, nectarines, 1.23 kg a.i./ha in 1000 L water. White beans, 1.23-1.58 kg a.i./ha. Potato (seed treatment), 50.0 g per 100 kg of cut seed. [3]

CARRIER: Water.

[iii] FORMULATIONS

1. WP
2. DU
3. GR

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: 0 m
3. Aerial application:	Calculated: 0 m
4. Forestry application:	Not identified.

3. STORAGE

Store in a cool, dry, ventilated place. Breaks down to carbendazim on prolonged storage of aqueous suspensions. Stable in sunlight.

4. HANDLING PRECAUTIONS

Do not graze animals on treated areas. Compatible with most pesticides; do not mix with lime or other alkaline materials.[2]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Long residual control. Persistence is about 3-4 weeks.[1] Methyl benzimidazole carbamate metabolite is relatively persistent and chemically stable.

[ii] AQUATIC – If released into water, thiophanate-methyl is not expected to adsorb to suspended solids and sediment based upon the estimated K_{oc}. Volatilization from water surfaces is not expected to be an important fate process.[5]

[iii] ATMOSPHERIC – If released to air thiophanate-methyl will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase thiophanate-methyl will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 5 hours. Particulate-phase thiophanate-methyl will be removed from the atmosphere by wet and dry deposition.5

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	7500 mg/kg	Males	1
Rat	LD_{50} oral	6640 mg/kg	Females	1
Rat	NOEL 2y	160 mg/kg diet		1
Rat	LD_{50} dermal	>10000 mg/kg		1
Mouse	NOEL	23.0 mg/kg		4
Rabbit	LD_{50} oral	2270 mg/kg	Males	1
Dog	NOEL 2y	50.0 mg/kg diet		1
Human	ADI	0.08 mg/kg	Estimated (rat data) (WHO/FAO 1974)	4
Japanese quail	LD_{50} oral	>5000 mg/kg		1
Rainbow trout	LC_{50} 48h	7.8 mg/L		1
Carp	LC_{50} 48h	11.0 mg/L		1
Daphnia	*EC_{50} 48h*	*20.2 mg/L*		*1*

[i] TOXICITY (OTHER) — Low acute toxicity in various animal species; shows pharmacological activity only at very high levels. Toxic to fish. Toxic to earthworms.[4] Non-toxic to bees.[1] Not carcinogenic in susceptible mouse strains. Three generation reproductive, mutagenicity, and cytogenicity studies (rat, dog) all negative. Two year studies (rat, dog) showed growth retardation only at high dietary levels.

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL – In rats, 61% and 35% is excreted in the urine and faeces, respectively, within 90 minutes of administration of an oral dose.[1]

[ii] PLANT - Degraded in plants to carbendazim and hydroxylated derivatives. Major metabolite in plants and soils is methyl benzimidazole carbamate; the minor metabolite 2-aminobenzimidazole is formed from this.[1] Carbendazim is also fungicidal with similar properties.

8. ADDITIONAL INFORMATION

Tolerant fungi strains have appeared in some areas in Europe. Some mite and nematode control has been observed. Compatible with most other agricultural chemicals, but not with alkaline pesticides or with copper compounds.

9. REFERENCES

1. PM
2. AC
3. PMRA
4. Wright, M.A. (1977) Effects of benomyl and some other systemic fungicides on earthworms. *Ann. Appl. Biol.* 87: 520-524.
5. HSDB

Thiram

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — thiram (BSI, E-ISO); thirame (F-ISO); TMTD (USSR); thiuram (JMAF)

[ii] TRADE NAME — Thiram (Wilbur-Ellis Company of Canada Ltd.); Vitavax, Anchor (Uniroyal Chemical Ltd.); Premiere (Zeneca Agro). Other names include Vitaflow, Thiralin Plus, Pfizer's Thiram, Niagra, Skoot.

[iii] CHEMICAL NAME — tetramethylthioperoxydicarbonic diamide

[iv] CAS # — 137-26-8

[v] TYPE / MODE OF ACTION — Organic compound used as a protective foliar fungicide, a seed treatment, and an animal repellent.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Foliar treatment on apples, bananas, celery, peaches, tomatoes, strawberries, and turf. Soil treatment of celery, cotton and onions. Seed treatment for beans, beets, broccoli, and many other crop plants. Pre-plant root dip on bulbs. Also applied as an animal repellent on fruit trees against a number of fungal diseases.

[i] APPLICATION — For seed treatment apply dry or in a slurry. For foliage a spreader-sticker should be used.[2] To repel animals apply before animal damage is expected. Ensure drying conditions are favourable. A semi-permanent type sticker gives residual action beyond three months.[2]

[ii] RATES — SEED TREATMENTS: Vegetable crops, 131.25-225 g a.i./100 kg seed. Soybeans, 9.9 g a.i./25 kg seed. Wheat, rye, 15.9-17.3 g a.i./25 kg seed.[3] FOLIAR SPRAYS, 1.2 g a.i./$10m^2$, 16.0-378 mL a.i./$100\ m^2$

CARRIER : Water.

[iii] FORMULATIONS

1. SU
2. PE
3. SN
4. GR
5. WP
6. DU

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Calculated: 31-34 m
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Decomposed in acidic media. Some deterioration occurs on prolonged exposure to air, heat, or moisture.[4]

4. HANDLING PRECAUTIONS

Do not use on plant parts to be used for food or feed. Excessive residues should be removed by washing, stripping, etc. Do not handle with bare hands.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Low to moderate persistence. Microbial degradation and hydrolysis occur under acidic conditions. Major metabolites are copper dimethyldithiocarbamate, dithiocarbamate and carbon disulfide.[4] Half-life is 15 days.[5] If well distributed in the soil the half-life is 1-2 days. 50.0 mg/kg applied to sandy soil persisted for 2 months.

[ii] AQUATIC — Broken down by hydrolysis and photodegradation. Thiram adsorbs onto suspended solids or sediments. Thiram is not expected to volatilize or bioconcentrate.[4]

[iii] ATMOSPHERIC – If released to the atmosphere, thiram will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase thiram will react with photochemically generated hydroxyl radicals with an estimated half-life of about 1 hour. Particulate-phase thiram may be physically removed from the air by wet and dry deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	1800 mg/kg		1
Rat	NOEL	2.5 mg/kg/d		1
Rat	LD$_{50}$ dermal	>1000 mg/kg		1
Mouse	LD$_{50}$ oral	1500-2000 mg/kg		1
Rabbit	LD$_{50}$ oral	210 mg/kg		1
Dog	NOEL	2.2 mg/kg/d		1
Mink	LC$_{50}$ F.T.	82.0 mg/kg diet	Adverse effects on feed consumption and body weight gain	6
Ferret	LC$_{50}$ F.T.	50.0 mg/kg diet	Adverse effects on feed consumption and body weight gain	6
Mallard	LC$_{50}$ dietary	673 ppm		5
Pheasant	LC$_{50}$ dietary	2800 ppm		5
Japanese quail	LD$_{50}$ oral	695 mg/kg		1
Redwing blackbird	LD$_{50}$ oral	300 mg/kg		1
Bluegill sunfish	LC$_{50}$ 48h	0.23 mg/L		1
Trout	LC$_{50}$ 48h	0.13 mg/L		1
Carp	LC$_{50}$	4.0 mg/L		5
Xenopus laevis	LC$_{50}$ 96h	0.013 ppm		4
Asellus aquaticus	LC$_{50}$ 96h	61.0 ppm		4
Gammarus pulex	LC$_{50}$ 24h	14.0 ppm		4
Gammarus pulex	LC$_{50}$ 96h	0.195 ppm		4
Daphnia	*EC$_{50}$ 48h*	*0.21 mg/L*		*1*

[i] TOXICITY (OTHER) — Non-toxic to bees (LD$_{50}$ >10.0 ug/bee).[1] Breakdown product, carbon disulfide, may cause damage to the liver.[5] May cause skin irritation. Irritates mucous membranes.[6] Non-toxic to birds, highly toxic to fish.[5] It is fetotoxic to mice and teratogenic to mice and hamsters.[6] Non-carcinogenic, high doses are required to cause teratogenic effects.[5]

[ii] PHYTOTOXICITY - Non-phytotoxic when used as directed.

7. METABOLISM

[i] ANIMAL – Main metabolites formed are COS and CS_2.[1]

[ii] PLANT - The major metabolite in plants is ethylene thiourea, followed by ethylene thiuram monosulfide and presumably ethylene thiuram disulfide and sulfur.[4]

8. ADDITIONAL INFORMATION

Compatible with common insecticides and fungicides. Seed treatment contains a red-coloured dye. Inhibits mold on sorghum seed heads.

9. REFERENCES

1. PM
2. AC
3. PMRA
4. HSDB
5. PP
6. Hornshaw, T.C., R.J. Nulerich and R.K. Ringer (1987) Toxicity of thiram (tetramethylthiuram disulfide) in mink and European ferrets. *Bull. Environ. Contam. Toxicol.* 38: 618-626.

Trichlorfon

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — trichlorfon (BSI (since 1984), E-ISO, F-ISO); chlorophos (USSR); metriphonate (BAN); DEP (JMAF); dipterex (former exception, Turkey)

[ii] TRADE NAME — *Neguvon*, Dipterex, Dylox (Bayer Inc. Ag. Div.); *Danex (Makhteshim-Agan of North America Inc.); Dutox.*

[iii] CHEMICAL NAME — dimethyl(2,2,2-trichloro-1-hydroxyethyl)phosphonate

[iv] CAS # — 52-68-6

[v] TYPE / MODE OF ACTION — Wide spectrum organophosphorus insecticide (phosphonate group) with stomach and contact action. Cholinesterase inhibitor.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

On field crops, against a variety of insects (moths, flies, bugs, etc.) and on forests, ornamentals, tobacco, and woodlands. Also widely used against ecto- and endoparasites of animals, in public health against flies, etc., and in medicine as an anthelminthic. Also used on poultry manure piles to control fly larvae.

[i] APPLICATION — FOLIAGE: Apply evenly at uniform rate, repeat as necessary. PREMISES and PUBLIC HEALTH: 1% active sugar fly baits; spray. LIVESTOCK (Neguvan TM): Pour-on or spray. Applied directly to plant foliage without need of spray emulsifiers or wetting agents. Sometimes applied as barrier strip around fields.

[ii] RATES — 1.2 mL a.i./50 kg body weight as a pour-on; 0.158-3.05 kg a.i./ha.

CARRIER: Oil. To livestock apply 16.0 g/ 50 kg body weight as a pour-on.

[iii] FORMULATIONS

1. PT
2. SN
3. EC
4. SP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0-8 m
2. Air blast application:	Calculated: 3(6)-8(17) m
3. Aerial application:	Calculated: 2-90 m
4. Forestry application:	Not identified.

3. STORAGE

Stable at room temperature; decomposed by water at higher temperatures and at pH <5.5 to dichlorvos. Subject to dehydrochlorination. Decomposition proceeds more rapidly with heating, and above pH 6. Photolysis is slow.[1]

4. HANDLING PRECAUTIONS

Do not use on animals <3 months old or on lactating dairy cattle; do not use on parts of building that animals can lick. Do not apply to beef cattle within 14 days of slaughter. Do not contaminate milking equipment, feed, or water. Do not use on greenhouse crops. Do not use on walls, floors, etc., previously treated with lime, whitewash or other alkaline materials. Compatible with chlorinated and phosphate insecticides; incompatible with alkaline material. May cause spotting to automobile paint. Not very effective against aphids, cabbage loopers, or mites. Has been used in forestry for the control of Balsam Fir sawfly.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Rapid breakdown in aerobic soils (Half-life ~3-27 days).[3] Does not sorb strongly to soil particles. Major breakdown product is dichlorvos. Decomposition occurs through the splitting of P-C bond and by hydrolysis of P-OCH_3 bonds.

[ii] AQUATIC — Degrades quickly by hydrolysis in alkaline waters (Half-life ~30-40 hours at pH<6). [2] However, in one study, it was shown to persist at detectable levels for 526 days.[6] Not expected to bioconcentrate in fish. Application of 1.1 kg/ha: residues of 0.0087-0.0593 mg/L found after 1 day. Toxicity in the field depends on several factors including pH, temperature, water hardness, and these factors may have different effects among species.[3]

[iii] ATMOSPHERIC — Degradation of trichlorfon vapour through reaction with hydroxyl radicals (estimated half-life 2.5 days).[2] Particulate trichlorfon will be removed by dry deposition.

[iv] PHYTODEGRADATION — Rapidly hydrolyzed in plants. Application of 1.1 kg/ha: after 14 days <0.1 mg/kg was found on Douglas fir and willow; <2.1 mg/kg found on grass.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	c. 250 mg/kg		1
Rat	LD_{50} dermal	>5000 mg/kg		1
Rat	NOEL	2.5 mg/kg/d		4
Rat	NOEL 2y F.T.	100 mg/kg diet	No ill effects	1
Dog	NOEL	1.25 mg/kg/d		4
Dog	NOEL 4y	50.0 mg/kg diet		1
Mallard	LD_{50} oral	36.8 mg/kg		3
Bobwhite quail	LD_{50} oral	22.4 mg/kg		3
Pheasant	LD_{50} oral	95.9 mg/kg	Males	3
Chicken	LD_{50} oral	125 mg/kg		2
Rainbow trout	LC_{50} 96h	0.7 mg/L		1
Rainbow trout	LC_{50} 96h	40900 µg/L	Temp 7°C; pH=6.5	7
Rainbow trout	LC_{50} 96h	2500 µg/L	Temp 17°C; pH=6.5	7
Rainbow trout	LC_{50} 96h	520 µg/L	Temp 7°C; pH=9.5	7
Rainbow trout	LC_{50} 96h	330 µg/L	Temp 17°C; pH=9.5	7
Cutthroat trout	LC_{50} 96h	1650 µg/L		5
Lake trout	LC_{50} 96h	0.55 mg/L	Static bioassay	2
Brook trout	LC_{50} 96h	2.5 mg/L	Static bioassay	2
Bluegill	LC_{50} 96h	0.26 mg/L		3
Channel catfish	LC_{50} 96h	0.88 mg/L		3
Golden orfe	LC_{50} 96h	0.52 mg/L		1
Fathead minnow	LC_{50} 96h	7.9 mg/L		2
Crayfish	LC_{50} 96h	7.8 mg/L	Static bioassay	3
Stonefly	LC_{50} 96h	0.01 mg/L		3
Anphipod and stonefly	LC_{50} 96h	5.3-100 µg/L		5
Gammarus fasciatus	LC_{50} 96h	40.0 µg/L	Static bioassay	2
Honey bee	LD_{50}	28.5 µg/g		
Leafcutting bee (male)	LD_{50}	250 µg/g		
Leafcutting bee (female)	LD_{50}	515 µg/g		
Daphnia	*EC_{50} 48h*	*0.96 mg/L*		*1*
Dacus cucurbitae	*LC_{50} 24h*	*0.035 mg/L*		
Dacus cucurbitae	*LC_{50} 48h*	*0.031 mg/L*		
Dacus cucurbitae	*LC_{50} 72h*	*0.018 mg/L*		

[i] TOXICITY (OTHER) — Cholinesterase inhibitor. Not toxic to bees once it has dried on the plant. Does not significantly affect most beneficial insects. Non-irritating to skin and eyes (rabbit).[1] Long-term rat studies inconclusive on carcinogenicity. Reproductive effects occur only at high doses and are unlikely in humans at expected exposure levels; can be mutagenic.[3]

[ii] PHYTOTOXICITY — Sorghum or milo severely injured. Injury reported on apple foliage and fruit, and on carnations and zinnias.

7. METABOLISM

[i] ANIMAL – Appears to be rapidly absorbed, distributed, metabolized, and excreted in animals. Can be converted in trace amounts to dichlorvos.[4] Activity attributed to metabolic conversion to dichlorvos. Detoxified in insects and higher animals by hydrolysis (Rozengart; *see* dimethoate). Can degrade through non-enzymatic dehydrohalogenation (*Ibid.*).

[ii] PLANT – Rapidly hydrolysed.[1] Does not persist on leaves or leaf litter. The approximate residual period is 7 to 10 days on plants.[3]

8. ADDITIONAL INFORMATION

Direct application to domestic animals may result, although for a limited period of time, in residues of varying magnitude in milk, meat, and fat. Residues may also occur in animal feed. Residues substantially disappear in food processing. They also degrade in storage, processing, and cooking of animal products.[4]

9. REFERENCES

1. PM
2. HSDB
3. PP
4. Vettorazzi, G. (1976) State of the art of the toxicological evaluation carried out by the Joint FAO/WHO Meeting on Pesticide Residues. II. Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews* 63: 1-44.
5. Woodward, D.F. and W.L. Mauck (1980) Toxicity of five forest insecticides to cutthroat trout and two species of aquatic invertebrates. *Bull. Environ. Contam. Toxicol.* 25: 846-854.
6. Pimentel, D. 1971. Ecological effects of pesticides on non-target species. Executive Office of the President's Office of Science and Technology. U.S. Government Printing Office, Washington, D.C.
7. Howe, G.E. et al. 1994. Effects of water temperature and pH on toxicity of terbufos, trichlorfon, 4-nitrophenol and 2,4 dinitrophenol to the amphipod *Gammarus pseudolimnaeus* and rainbow trout (*Oncorhynchus mykiss*). *Environmental Toxicology and Chemistry* 13 (1).

Triclopyr

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — triclopyr (BSI, E-ISO, F-ISO, ANSI, WSSA); exception (Eire)

[ii] TRADE NAME — Garlon 4, Release (Dow Elanco Canada Inc.) Other names include Garlon 3A, *Fencerow*, and Dowco 233.

[iii] CHEMICAL NAME — 3,5,6-trichloro-2-pyridyloxyacetic acid

[iv] CAS # — 55335-06-3

[v] TYPE / MODE OF ACTION — Selective systemic herbicide (picolinic acid derivative). Absorbed by the roots and foliage, triclopyr accumulates in meristematic tissue where it induces auxin-like responses.[1]

2. USE PATTERN

For control of woody plants and broadleaf weeds on rights-of-way, forests, non-cropland, and industrial sites. Important weeds controlled: pines, sassafras, hemlock, poison oak, maples, oaks, locust, manzenita, blackberries, cherry, willows, rose, mesquite, and many other perennial weed and brush species.

[i] APPLICATION — Apply when brush species are actively growing. Applied as a broadcast foliar spray. May also be injected into the tree or applied to freshly cut stumps to prevent resprouting. May be applied by air.

[ii] RATES — Woody plant control, 1.92-3.84 kg a.i./ha in 200 L water. Broadleaved weed control, 0.48-1.92 kg a.i./ha in 200 L water.[3] 0.24-3.36 kg a.i./1000 L water as a high volume spray.[2]

CARRIER: Water, oil.

[iii] FORMULATIONS

1. 300 and 400 g/L as the amine salts and ester formulation.[2]
2. EC

[iv] SUGGESTED AQUATIC SET BACKS

1.	Ground application:	Not identified.
2.	Air blast application:	Not identified.
3.	Aerial application:	Label: 4-487 m **(see label for spray specific set backs)**
4.	Forestry application:	Label: 4-487 m **(see label for spray specific set backs)**

3. STORAGE

Store above –2°C, and agitate container before use. Stable under normal storage conditions and to hydrolysis. Subject to photolysis (Half-life ~12 hours).[1]

4. HANDLING PRECAUTIONS

Keep out of reach of children. Avoid contamination of food. Wash thoroughly after use. Avoid spray drift as small quantities of the spray may injure susceptible crops.[3] Because of the volatility of the ester formulation, it is recommended not to apply the active ingredient on days when the air temperature is expected to exceed 25°C.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Degrades rapidly in soil,[2] but with very little production of metabolites.[6] Under non-leaching conditions which favour microbial activity, half-life averages 46 days.[1]

[ii] AQUATIC — Half-life ranges from 2.8-14.1 hours.[4] Photolysis is the important fate process. If released into water, triclopyr is not expected to adsorb to suspended solids and sediment based upon its range of K_{oc} values. Triclopyr degraded slowly in a soil:water system incubated aerobically; the half-life is 142 days. Volatilization from water surfaces is not expected to be an important fate process.[8]

[iii] ATMOSPHERIC - If released to air triclopyr will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase triclopyr will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 3.3 days. Particulate-phase triclopyr will be removed from the atmosphere by wet and dry deposition.[8]

[iv] PHYTODEGRADATION — The half-life of triclopyr on plant surfaces is about 3-10 days.[1] This is due to a combination of metabolism, growth dilution, wash-off, volatilization, and photodegradation.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	630-729 mg/kg		4
Rat	NOEL 2y	3.0 mg/kg/d		1
Mouse	NOEL 2y	5.3 mg/kg diet		1
Guinea pig	LD_{50} oral	310 mg/kg		4
Rabbit	LD_{50} oral	550 mg/kg		4
Rabbit	LD_{50} dermal	>2000 mg/kg		1
Rabbit	LD_{50} dermal	>4000 mg/kg	Formulations	4
Mallard	LD_{50} oral	1698 mg/kg		1
Bobwhite quail	LC_{50} dietary	2935 mg/kg		1
Japanese quail	LC_{50} dietary	3278 mg/kg		1
Rainbow trout	LC_{50} 96h	0.74 mg/L		4
Rainbow trout	LC_{50} 96h	117 mg/L		1
Bluegill sunfish	LC_{50} 96h	0.87 mg/L		4
Bluegill sunfish	LC_{50} 96h	148 mg/L		1
Rainbow	LC_{50} 24h	8.4 mg/L		7
Rainbow	LC_{50} 96h	7.5 mg/L		7
Coho	LC_{50} 24h	9.9 mg/L		7
Coho	LC_{50} 96h	9.6 mg/L		7
Chum	LC_{50} 24h	7.9 mg/L		7
Chum	LC_{50} 96h	7.5 mg/L		7
Sockeye	LC_{50} 24h	7.8 mg/L		7
Sockeye	LC_{50} 96h	7.5 mg/L		7
Chinook	LC_{50} 24h	9.7 mg/L		7
Chinook	LC_{50} 96h	9.7 mg/L		7
Pink	LC_{50} 24h	13.3 mg/L		7
Pink	LC_{50} 96h	5.3 mg/L		7
Daphnia	*EC_{50} 48h*	*133 mg/L*		*1*

[i] TOXICITY (OTHER) — Harmful if swallowed. Causes mild eye and skin irritation. Toxic to fish. Non-toxic to bees (LD_{50} >100 µg/bee).[1] Practically non-toxic to birds and fish; little if any potential to accumulate in aquatic organisms.[4] Unlikely to be teratogenic, mutagenic, or carcinogenic.[4]

[ii] PHYTOTOXICITY – Clovers are sensitive, as also are larch, lodgepole pine, ornamentals, and edible crops.[1]

7. METABOLISM

[i] ANIMAL – A 454.4 mg dose was given to cows over a 4 day period. 392.7 mg were recovered in the urine. No traces were found in milk or faeces.[5]

[ii] PLANT - Absorbed by both the leaves and roots and readily translocated throughout the plant. DT_{50} is approximately 3-10 days.[1]

8. ADDITIONAL INFORMATION

Best results are obtained when the soil moisture is adequate for normal plant growth. Most effective on root suckering species of brush. Established grasses are not injured by rates needed for weed and brush control. Water solubility is 430 mg/L.

9. REFERENCES

1. PM
2. AC
3. PMRA
4. PP
5. Eckerlin, R.H. *et al.* (1987) Excretion of Triclopyr herbicide in the Bovine. *Bull. Environ. Contam. Toxicol.* 39: 443-447.
6. Norris, L.A., M.L. Montgomery and L.E. Warren (1987) Triclopyr persistence in Western Oregon hill pastures. *Bull. Environ. Contam. Toxicol.* 39: 134-141.
7. Wan, M.T., D.J. Moul and R.G. Watts (1987) Acute Toxicity to Juvenile Pacific Salmonids of Garlon 3A™ Garlon 4™, Triclopyr, Triclopyr Ester, and their Transformation Products: 3,5,6-Trichloro-2-pyridinol and 2-methoxy-3,5,6-trichloropyridine. *Bull. Environ. Contam. Toxicol.* 39: 721-728.
8. HSDB

Trifluralin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — trifluralin (BSI, E-ISO, ANSI, WSSA, JMAF); trifluraline (F-ISO)

[ii] TRADE NAME — Treflan, Elanco, Heritage (Dow Agrosciences Canada Inc.); Rival (Bayer Crop Science Inc.); *Triflurex (Makhteshim-Agan (AM) Inc.)*; Fortress (Monsanto Canada Inc.)

[iii] CHEMICAL NAME — a,a,a-trifluoro-2,6-dinitro-*N*,*N*-dipropyl-*p*-toluidine

[iv] CAS # — 1582-09-8

[v] TYPE / MODE OF ACTION — A dinitroaniline compound used as a selective pre-emergence herbicide.

2. USE PATTERN

Used on ornamentals, tobacco, and shelterbelts, and on crops including alfalfa, almonds, apricots, broccoli, Brussel sprouts, cabbage, cantaloupes, carrots, castor beans, cauliflower, celery, cherries, collards, corn, and cucumbers. Used on many fruit and vegetable plants as well as on wheat to control barnyard grass, cheat, chickweed, crabgrass, foxtails, panicum, goosegrass, shattercane, johnsongrass, lambsquarters, pigweed, puncture vine, purslane, Russian thistle, sandbar, strangle top, stink grass, and other weeds.

[i] APPLICATION — GENERAL: incorporated into the soil 5-10 cm deep, within 24 hours after application. Common soil incorporation equipment from double discing to power and ground-driven rotary tillers have proven most effective. Pre-plant incorporation is most commonly used but post-plant can be used. May be applied by air.

CROP USAGE:

COTTON, SOYBEANS, AND DRY BEANS – Apply prior to planting; use broadcast treatment. Used as a layby treatment. May be applied in the fall.

SAFFLOWER – Apply as overall treatment by double discing.

VEGETABLE CROPS – Apply to soil prior to seeding or transplanting. Layby treatment may be used.

SUGAR BEETS – Layby treatment at thinning time. A directed spray may be used, working into the soil in rows. Do not apply pre-emergence. Apply when beets are 2-15 cm tall.

VINEYARDS, ORCHARDS, NURSERY STOCK – Applied to soil prior to planting or applied to established plantings. Gladioli corms less than 2.5 cm diameter may be injured if applied pre-plant.

ALFALFA – Apply over the top of established alfalfa during the dormant period or after removal of foliar growth.

MELONS – Apply as layby treatment when crop is in the 3-4 leaf stage. Use a directed spray.

POTATOES – Applied up to or immediately after drag-off.

SUGARCANE – In Hawaii apply as a post plant surface application to plant cane. Use 4.4 kg/ha. In other areas apply pre-emergence or at emergence and incorporate into soil.

WHEAT – Applied pre-plant and soil incorporated.

BINDWEED CONTROL – Subsurface injection forming a layer placed 10-15 cm deep.

JOHNSONGRASS RHIZOME CONTROL IN SOYBEANS and COTTON – Apply at double rate two years in a row. Deep incorporation necessary.

[ii] RATES — 0.420-4.38 kg a.i./ha in 100-450 L of water. Lower rates in sandy soil.[3]

CARRIER: Water.

[iii] FORMULATIONS

1. EC
2. GR
3. Liquid-4 EC and 5% granular forms.
4. WG

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Label: 50 m **(product containing flumetsulam (30g/L) and trifluralin (408 g/L))**
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable but subject to photochemical decomposition. Non-corrosive. Stable at 52% C . Stable to hydrolysis at pH values of 3, 6 and 9. Decomposed by ultraviolet irradiation.[1]

4. HANDLING PRECAUTIONS

Incorporate within 24 hours to prevent loss of activity. Do not allow to freeze. Any condition which places a stress on the crop may increase the possibility of crop injury from this herbicide. Effective on peat or muck soils containing up to 20% organic matter. May be combined with dry and liquid fertilizer.

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL — Six months in soil. Loss in soil of 85-90% in 0.5-1.0 year.[4] Trifluralin gives a full season of weed control. Carryover may occur in certain areas, causing injury to some crops.[3] Absorbed by soil and very resistant to leaching. Very little lateral movement in the soil. DT_{50} 57-126 days. Duration of residual activity in soil is 6-8 months.[1]

[ii] AQUATIC – Nearly insoluble in water. It will probably be found absorbed to soil sediments and particulates in the water column.[6]

[iii] ATMOSPHERIC – If released to air trifluralin will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase trifluralin will be degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals; the half-life for this reaction in the air is estimated to be 16 hours. Direct photolysis is expected to be an important environmental fate process based upon the observed half-life for trifluralin in July sunlight which ranged from 25-60 minutes. Particulate-phase trifluralin will be removed from the atmosphere by wet and dry deposition.[7]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	>10,000 mg/kg		2
Mouse	NOEL	73.0 mg/kg/d		1
Rabbit	LD_{50} dermal	>5000 mg/kg		1
Dog	LD_{50}	>2000 mg/kg		
Bobwhite quail	LD_{50} oral	>2000 mg/kg		1
Mallard	LC_{50} dietary 5d	>5000 mg/kg		1
Bluegill sunfish	LC_{50} 96h	0.02-0.09 mg/L		1
Rainbow trout	LC_{50} 96h	0.01-0.04 mg/L		1
Channel catfish	LC_{50} 96h	0.417 mg/L	Fingerlings	
Harlequin fish	LC_{50} 24h	0.3 mg/L		
Grass shrimp	LD_{50} 96h	0.64 mg/L		1
Stonefly	LC_{50} 24h	13.0 mg/L		
Stonefly	LC_{50} 48h	4.2 mg/L		
Gammarus lacustris	*LC_{50} 24h*	*8.8 mg/L*		
Gammarus lacustris	*LC_{50} 48h*	*5.6 mg/L*		
Daphnia	*EC_{50} 48h*	*0.56 mg/L*		*1*

[i] TOXICITY (OTHER) — Dinitroanilines are generally considered to have a very low degree of toxicity to animals.[5] Non-irritaing to skin; slightly irritating to eyes (rabbits).[1] Practically non-toxic to birds, very highly toxic to fish and other aquatic organisms, non-toxic to bees.[6] Unlikely effects on reproduction will be produced in humans at expected exposure levels. Does not appear to be teratogenic, no evidence of mutagenicity.[6]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – Residues accumulate in fat, but decline rapidly (fish). Degradation in animals is as for soil. Following oral administration, approximately 70% is eliminated in the urine and 15% in the faeces within 72 hours.[1]

[ii] PLANT – Degradation in plants is as for soil.[1] Not translocated into the leaves, seeds, or fruit of most plants.[6]

8. ADDITIONAL INFORMATION

Rainfall not required to activate chemical. Soil incorporation makes chemical most effective.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Worthing, C.R. The Pesticide Manual - A World Compendium. 8th edition. The British Crop Protection Council, 1987. 1081 pp.
5. Doull, J., C.D. Klaasen and M.O. Amdus (1980) *Casarett and Doull's Toxicology*. Macmillan Publ. Co. Inc., New York. 778 pp.
6. PP
7. HSDB

Triforine

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — triforine (BSI, E-IS0, F-ISO, ANSI, JMAF)

[ii] TRADE NAME — Funginex ,190 EC (BASF Canada.); Green Cross Rose and Ornamental Fungicide.

[iii] CHEMICAL NAME — *N,N'*-{piperazine-1,4-diylbis[(trichloromethyl)methylene]}diflormamide

[iv] CAS # — 26644-46-2

[v] TYPE / MODE OF ACTION — A piperazine derivative used as a systemic fungicide with protective and curative effects.[3]

2. USE PATTERNS

For use against powdery mildew, scab, rust and other diseases of fruits, vegetables, cereals, and ornamentals.[3] It is active against storage diseases of fruit and supresses red spider mite activity.[3] Triforine also inhibits lesion development in peaches.[4]

[i] APPLICATION — Used as a foliar application. Repeat at 1-2 week intervals.[3] May be applied by air. May be mixed with other pesticides. Do not mix with wetting agents, spreader stickers, or other adjuvants.[3]

[ii] RATES — 1.9 mL a.i./L water. Used as a seed treatment at 270 g a.i./100 kg seed.[3] 190-360 g a.i./ha in 50-1000 L water.

CARRIER: Water.

[iii] FORMULATIONS

1. EC

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0 m
2. Air blast application:	Calculated: 0 m
3. Aerial application:	Calculated: 0 m
4. Forestry application:	Not identified.

3. STORAGE

Store in a cool, dry place. Avoid prolonged exposure above 37.8°C. Do not allow to freeze.[3] Decomposed in aqueous solution exposed to ultraviolet or daylight. Decomposed in strongly acidic media and in strongly alkaline media; DT_{50} 3.5 days.[1]

4. HANDLING PRECAUTIONS

Wear goggles or face shield and rubber gloves when handling. Do not let spray mixture stand in tank overnight. Should not be mixed with wetting agents, spreader-stickers, or other adjuvants.[1]

5. ENVIRONMENTAL PERSISTENCE

[I] SOIL — Non-persistent in soil, with a half-life of approximately three weeks.[3] In soils, a range of non-fungitoxic metabolic end-products is formed, presumably including piperazine.[1] Does not accumulate in the environment.[1]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD$_{50}$ oral	>16000 mg/kg	Technical grade	2
Rat	LC$_{50}$ inhalation 1h	>4.5 mg/L		1
Rat	NOEL 2y	625 mg/kg diet		1
Mouse	LD$_{50}$ oral	>6000 mg/kg		1
Rabbit	LD$_{50}$ dermal	>10000 mg/kg		1
Dog	NOEL 2y	100 mg/kg diet		1
Human	ADI	0.02 mg/kg b.w.		1
Bobwhite quail	LD$_{50}$ oral	>5000 mg/kg		1
Bluegill	LC$_{50}$ 96h	>1000 mg/L		1
Rainbow trout	LC$_{50}$ 96h	>1000 mg/L		1
Daphnia	*EC$_{50}$ 48h*	*117 mg/L*		*1*

[i] TOXICITY (OTHER) — No toxic effect observed in honeybees at <1000 mg/kg diet.[1] Harmless to beneficial arthropods.[1] Non-toxic to fish.

[ii] PHYTOTOXICITY — Phytotoxic to certain types of pears and apples. May cause slight russeting in very susceptible apple varieties. Do not spray open blooms.

7. METABOLISM

[i] ANIMAL – Not identified.

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. PM
2. FCH
3. AC
4. Fourie, J.F. and G. Holz (1988) Post-harvest fungicidal treatment of stone fruit for the control of *Monilinia laxa, Botrytis cinerea* and *Rhizopus stolunifer. Phytophylactica* 19: 73-77.

Warfarin

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — warfarin (BSI, E-ISO, BAN); warfarine (F-ISO); coumafene (France); zoocoumarin (USSR); coumarins (JMAF); exception (The Netherlands)

[ii] TRADE NAME — Warfarin Plus, Kypfarin, Ratox, RAX, and Tox-Hid. Manufacturers include All India Medical Corp. (India), Jewnin-Joffe Chemicals Ltd (Israel), Prentiss Drug and Chemical Co., Roberts Laboratories, Div. of Hopkins, Agricultural Chemical Co., and Velsicol Chemical Corp.

[iii] CHEMICAL NAME — 4-hydroxy-3-(3-oxo-1-phenylbutyl)-2*H*-1-benzopyran-2-one

[iv] CAS # — Not identified.

[v] TYPE / MODE OF ACTION — Anticoagulant rodenticide. Continued eating counters the action of Vitamin K in the body. The prothrombin content of the blood is reduced and general internal bleeding is induced. The rodent dies of internal bleeding and anemia.[3]

2. USE PATTERN

Controls Norway rats and house mice.[2]

[i] APPLICATION — Mixed with baits or water. Up to 5% edible oil may be mixed with dry baits to prevent dust around area. Set out in an adequate number of places replacing as food is consumed. Continue until lack of feeding is noted; usually 5-15 days. Continuous uninterruption in feeding program gives best control. Use water baits in grain warehouses as food competition with dry baits may exist. No pre-baiting needed since there in no bait shyness.[1]

[ii] RATES — Applied in cereal baits at 0.025-0.5% active material and in water baits at 0.005-0.006% levels. The 0.5% powder is mixed with dry bait material at a 19:1 ratio to get the required concentration.[3]

CARRIER: Rodent drink (water) or in food products.[3]

[iii] FORMULATIONS

1. Numerous
2. SP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application: Not identified.
2. Air blast application: Not identified.
3. Aerial application: Not identified.
4. Forestry application: Not identified.

3. STORAGE

Stable for >3 years. Very stable, even to strong acids.[1] Discolored by light. Do not store near feeds, foodstuffs, flame or heat.[4]

4. HANDLING PRECAUTIONS

Tasteless and odourless. Keep away from children and household pets. Give massive doses of Vitamin K as an antidote. Compatible with other rodenticides.[1] Wear appropriate clothing to prevent repeated or prolonged skin contact. Employees should wash promptly when skin is wet or contaminated. Work clothing should be changed daily if it is possible that clothing is contaminated. Remove non-impervious clothing promptly if wet or contaminated.[4]

5. ENVIRONMENTAL PERSISTENCE

[i] SOIL – If released to soil, warfarin is expected to have low soil mobility based on estimated K_{oc} values of 701 and 918. Volatilization from moist soil surfaces is not expected to be an important fate process. Warfarin (sodium salt) was considered "not readily biodegradable" with only a 13% degradation (COD reduction) over a 28-day incubation period using activated sludge.[4]

[ii] AQUATIC – If released into water, warfarin is expected to adsorb to suspended solids and sediment based upon the K_{oc}. Volatilization from water surfaces is not expected to be an important fate process. An estimated BCF of 24 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis occurs very slowly in water with a half-life (pH 7, 25°C) of 16 years.[4]

[iii] ATMOSPHERIC – If released to air warfarin will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be about 2.4 hours. Particulate-phase warfarin will be removed from the atmosphere by wet and dry deposition.[4]

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

[i] TOXICITY (OTHER) - In animals, a single large dose is about as toxic as a single small dose. On a multiple dose basis the LD100 is 0.2 mg/kg/d for 5 days (rat). Chickens are relatively resistant. Organ damage is observed, as well as inhibition of blood coagulation. Only slightly dangerous to humans and domestic animals when used as directed, but care must be taken with young pigs, which are especially susceptible.[1]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL – There has been no development of tolerance in rodents after ingestion and apparently neither sex nor age of the rat or mouse causes any difference in effectivenss.[4] Rats injected intraperitoneally with [14]C warfarin excreted approximately 90% of the activity in 14 days, about half in the urine and half in the feces.[4]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

There is no bait shyness but repeated ingestion is needed to produce toxic conditions. Resistant strains of rats and mice are developing.

9. REFERENCES

1. PM
2. FCH
3. AC
4. HSDB

Zinc phosphide

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — The traditional chemical name zinc phosphide (E-ISO, JMAF); phosphure de zinc (F-ISO) is accepted in lieu of a common name.

[ii] TRADE NAME — ZP (Bell Labratories Inc.); Clean Crop (United Agri Products); *Mouse Bait, Phosvin, Zinc-Tox (Hooker Chemical Corp.)*

[iii] CHEMICAL NAME — trizine diphosphide

[iv] CAS # - Not identified.

[v] TYPE / MODE OF ACTION — Inorganic rodenticide.

2. USE PATTERN

Gives control of rats, mice, ground squirrels, prairie dogs, rabbits, voles, muskrats, nutria, etc.

[i] APPLICATION — Place bait in places where rodents will be brought into contact. Replenish supply as necessary. Bait entire premises at one time. Collect and destroy all uneaten bait and dead bodies after two days. Do not repeat at less than 1 month intervals.

[ii] RATES — 90.0-180 g a.i./ha; 0.3 g a.i./3m. Kills rodents in one feeding.[2]

CARRIER: Not identified.

[iii] FORMULATIONS

1. PT
2. DU
3. PE

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Not identified.
2. Air blast application:	Not identified.
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Stable when dry; decomposes in moist air. Store in cool, dry, fire-resistant area away from acids or water solutions. Decomposed violently by acids to produce phosphine (very toxic to mammals) and impurities which render gas spontaneously flammable. Slightly corrosive to metal. Store in cool, dry, fire-resistant area away from acids or water solutions. Handle carefully to avoid unnecessary dusting. Take great care to keep away from children, domestic animals, food, and feedstuffs. Improper storage can cause explosion and fire hazards.[4]

4. HANDLING PRECAUTIONS

Handle carefully to avoid unnecessary dusting. Wear appropriate chemical protective boots, protective gloves, and goggles. Wear positive pressure self-contained breathing apparatus when fighting fires involving this material.[4]

5. ENVIRONMENTAL PERSISTENCE

Under exposed conditions, toxicity lost within approximately 2 weeks (water soluble). Remains active for several months.[2]

[i] SOIL – Soil activity and moisture tend to accelerate the breakdown of the compound. Phosphine gas may be liberated as a result of this process[3]

[ii] AQUATIC – Not identified.

[iii] ATMOSPHERIC – Not identified.

[iv] PHYTODEGRADATION – Not identified.

[v] OTHER – Not identified.

6. TOXICITY

LD_{50} oral for rats is 45.7 mg/kg.[2] Intense poison to mammals, birds, and all types of animal life. Black colour and characteristic phosphine odour of bait render some degree of protection (garlic-like odour and taste). Mutagenicity is unclear.[3]

[i] TOXICITY (OTHER) – Very toxic to mammals. Highly toxic to wild birds and freshwater fish.[3]

[ii] PHYTOTOXICITY – Not identified.

7. METABOLISM

[i] ANIMAL - Popular for control of rats in open-face dumps; sometimes mixed with tartar-emetic so that vomiting will occur before poisoning occurs in desirable animals. There is little tendency for the compound to concentrate in living tissue, as it is readily converted to phosphine.[3]

[ii] PLANT – Not identified.

8. ADDITIONAL INFORMATION

None identified.

9. REFERENCES

1. FCH
2. AC
3. PP
4. HSDB

Zineb

1. DESCRIPTION OF CHEMICAL

[i] COMMON NAME — zineb (BSI, E-ISO, JMAF); zinebe (F-ISO); exception (FRG)

[ii] TRADE NAME — Zineb (United Agri Products); *King Zineb (King Pesticides Ltd.)*; *Dithane (Rohm and Haas Canada Inc.)*; Pfizer's Zineb (Pfizer C and G Inc.); Later's Zineb (Later's Chemicals Ltd.). Other names include Thiogreen and Thiodan 2-zineb 5.

[iii] CHEMICAL NAME — zinc(ethylenebis)dithiocarbamate (polymeric)

[iv] CAS # — 12122-67-7

[v] TYPE / MODE OF ACTION — Carbamate compound used as a protective foliar fungicide.

[vi] NOTICE — **Active is under re-evaluation.**

2. USE PATTERN

Prevents mildew, rust, damping off, fire blight, and other diseases on numerous fruit crops, vegetable crops, and ornamentals.

[i] APPLICATION — Applied when disease threatens, usually at 7-10 day intervals. FOLIAGE: Apply evenly and thoroughly during the growing season at 1-2 week intervals, up to the day of harvest. SOIL: Drench or dry soil treatment at specified intervals. SEED TREATMENT: Apply dry or as a slurry. May be mixed with captan.

[ii] RATES — Vegetable crops, 1.4-2.6 kg a.i./ha. Apple, pear, 3.4-5.4 kg a.i./ha.[3]

CARRIER: Water at 800-1500 L.

[iii] FORMULATIONS

1. DU
2. WP

[iv] SUGGESTED AQUATIC SET BACKS

1. Ground application:	Calculated: 0-1 m
2. Air blast application:	Calculated: 1(2)-4(9) m
3. Aerial application:	Not identified.
4. Forestry application:	Not identified.

3. STORAGE

Store in dry, well-aired areas. Non-volatile under normal field conditions. Somewhat unstable to light, heat, and moisture. Store in fresh (less than 30°C), dry area away from dwellings, animal shelters and stored food.[4]

4. HANDLING PRECAUTIONS

Do not use treated seed for feed or food. Non-compatible with alkaline or mercury compounds. Compatible with other fungicides and insecticides. Personal protective equipment should be issued to workers engaged in prodn of carbamates or in their agricultural use, in particular eye protections and respirators to those who spray crops.[4]

5. ENVIRONMENTAL PERSISTENCE

Only small quantities find their way into the soil, and once there are rapidly degraded.[6]

[i] SOIL — Half-life is 16-23 days.[4] Low persistence in soil (persists for >75 days). Adsorbs strongly to soil particles and usually does not move below the upper layer of soil.[5] Rapidly degraded to ethylene thiourea (ETU), ethylene thiuram mono-sulphide, CS_2, and H_2S. Ethylene thiourea is further degraded to ethylene urea.[6]

[ii] AQUATIC — If released into water, zineb will adsorb to sediment and particulate matter and undergo hydrolysis.[4] Volatilization from water surfaces is not expected to be an important fate process.[4]

[iii] ATMOSPHERIC – If released to air zineb will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase zineb will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 2.5 hours. Particulate-phase zineb will be removed from the atmosphere by wet and dry deposition.[4]

[iv] PHYTODEGRADATION — Half-life on leaves is 14 days.

[v] OTHER - Not identified.

6. TOXICITY

Animal	*Test*	*Dose*	*Comments*	*Ref.*
Rat	LD_{50} oral	1850-8900 mg/kg		5
Rat	LD_{50} dermal	>6000 mg/kg		1
Mouse	LD_{50} oral	7600 mg/kg		4
Dog	LD_{50} oral	>5000 mg/kg		4
Human	ADI	0.03 mg/kg		1
Mallard	LD_{50} oral	>2000 mg/kg		5
Pheasant	LD_{50} oral	>2000 mg/kg		5
Japanese quail	LC_{50} oral	>5000 ppm	Technical grade in corn oil	4
Perch	LC_{50} 96h	2.0 mg/L		5
Roach	LC_{50}	6.0-8.0 mg/L		1

[i] TOXICITY (OTHER) — Not toxic to bees.[1] Practically non-toxic to birds, moderately toxic to fish.[5] Degradation product, ETU, is carcinogenic.[6] No evidence of teratogenic effects in rats or mice at levels below maternal toxicity.[7]

[ii] PHYTOTOXICITY — Generally non-phytotoxic except to zinc-sensitive varieties such as tobacco and cucurbits. Pears have been slightly injured in a few cases.

7. METABOLISM

[i] ANIMAL – Rapidly excreted following ingestion. In mammals, zineb is metabolized into ETU and carbon disulphide. In rats, 11-17% of an oral dose was absorbed from the gastrointestinal tract.[5] In plants, ethylene thiourea is the major metabolite. Ethylene thiuram monosulfide and presumably ethylene thiuram disulfide and sulfur are also formed.[4]

[ii] PLANT – ETU is the major zineb metabolite in plants.[5]

8. ADDITIONAL INFORMATION

Plants growing on treated soil will take up residues of this compound and those of ethylene thiourea.[6] Cooking vegetables containing ethylenebisdithiocarbamates release ethylene thiourea.[6]

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APPENDIX I

Calculated and Label Suggested Aquatic Set Backs

Calculated and Label Suggested Aquatic Set Backs

This document provides suggested aquatic set backs or buffer zones to be observed during agricultural applications of pesticides. Both calculated and Pest Management Regulatory Agency (PMRA) label recommended set backs have been provided. The most restrictive set back has been listed where both a label and a calculated set back suggestion were available. Aquatic set backs have been derived for the appropriate application method and may range from product to product depending upon the active ingredient content. The suggested set backs for each active ingredient, reflect the most sensitive aquatic animal NOEC (no observed effect concentration). Where a NOEC value was not available, the LC_{50} (lethal concentration where 50% of a test population dies in a laboratory experiment) with a 10 x margin of safety factor was used. All calculated set backs were determined using toxicity to aquatic animals only, and therefore do not address the possible impact of pesticides on aquatic plants. Calculated set backs for ground and airblast applications were derived using the PMRA Excel Workbook (1996). Calculated aerial and forestry set backs were derived using the AgDRIFT model. All label required set backs, (marked with an asterisk (*) in the table), were extracted from the individual product labels provided through the PMRA. These product labels may include pesticides with one or more active ingredient. In some cases, the other active ingredients were considered to be more toxic to aquatic receptors than the compound being addressed, and therefore the reason for the greater set back distance. Where this is the case, this has been indicated in the Usage Pattern Comments column. Individual labels for specific pesticide formulations should be consulted prior to use near aquatic systems.

For those pesticides with a set back listed of 0 m, this should be interpreted as being either 0 m from the edge of the water body, or 0 m from the edge of legislated buffer zone or riparian area.

For Calculated Ground and Airblast Applications (using PMRA Dataset):

- aquatic set backs ensure the expected environmental concentration (EEC), dispersed through a water body, does not exceed the NOEC of the most sensitive endpoint;
- aquatic set backs do not account for different application arrangement and meteorology, calculations were made based on upper windspeed limits (16 km/hr);
- watercourse depths of 30cm were assumed for agricultural applications and depths of 15cm were assumed for forestry applications;
- set backs which were determined for early season spraying (little or no foliage) are shown bracketed, set backs determined for late season spraying (full foliage) are shown without brackets.

For Calculated Aerial and Forest Applications using the AgDRIFT model:

- input differences for forestry and agricultural sprays were noted as below;

Pesticide	Vmd (um)	ASAE Spray Category	Boom Ht (m)	Default Spray Rate (L/ha)	Surface Roughness (m)	Partition Fraction	Pond Depth (cm)
Insecticide - Agriculture	180	Fine	3.05	30	0.0152	N/A	30
Herbicide - Agriculture	255	Fine to Medium	3.05	100	0.0152	N/A	30
Fungicide - Agriculture	255	Fine to Medium	3.05	100	0.0152	N/A	30
Insecticide - Forestry	137	Very Fine to Fine	15	5	1	1:1	15
Herbicide - Forestry	255	Fine to Medium	15	50	1	N/A	15

- the boom heights for forestry were measured from top of canopy;
- for Vmd (volume median diameter) of emitted spray - ASAE (American Society of Agricultural Engineers) default categories were used to define drop size distribution;
- a default was used if spray rate was not specified;

- surface roughness, the height of the apparent surface cover on the ground beneath the aircraft and downwind, was assumed to be 1/30 of the height of the actual surface cover;
- the ratio of pesticide that deposits in the canopy to that which reaches pond surface (partition fraction) was only considered for forestry insecticide sprays;
- meteorology was defaulted to 25°C, 50% relative humidity and winds of 16 km/ph;
- product was assumed to be non-volatile with a specific gravity of 1.0, only the aqueous portion of the tank mix was assumed to evaporate.

References:

LC_{50} values:

Environment Canada, Environmental Protection Branch. 2003 Pesticide Compendium. Minister of Public Works & Government Services Canada, 2003.

Application rates and label suggested aquatic set backs:

Label Information as provided by the Pest Management Regulatory Agency (PMRA) (http://www.hc-sc.gc.ca/pmra-arla). Extracted November 2002.

Calculated ground and airblast set backs:

Ganzelmeier, H; Rautmann, D; Spangenberg, R; Streloke, M; Herrmann, M; Wenzelburger, H-J; Walter, H-F. 1995. Studies on the spray drift of plant protection protection products: Results of a test program carried out throughout the Federal Republic of Germany. Report Number 305 from the Biologischen Bundesanstalt fhr Land- und Forstwirtschaft, Berlin-Dahlem. Blackwell Wissenschafts-Verlag GmbH, Berlin/Vienna.

Nordby, A and Skuterud, R. 1975. The effects of boom height, working pressure and wind speed on spray drift. Weed Research 14: 385-395.

Pest Management Regulatory Agency. PMRA Excel Workbook. 1996.

AgDRIFT Calculations:

Spray Drift Task Force Modeling Subcommittee. AgDRIFT Model Version 2.0.05. August 2001.

Active Ingredient	RATE i.a.	LC_{50} (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
1-Napthylacetic Acid	120 g/ha	57 (96h RT)	0	0	N/I	N/I	N/I
2,4-D	0.55-30 L/ha	1.4 (96h RT)	50	N/I	N/I	N/I	50m set back is applicable specifically for the pesticide containing 50% 2,4-D, 9.3% flumetsulam and 25% clopyraild, as clopyralid has the highest acute toxicity to aquatic
2,4-DB	0.22-2.2 kg a.i./ha in 46-55 L water	4 (96h RT)	0	N/I	0	N/I	N/I
4-AP		3.2-3.4 (Bluegill)	N/I	N/I	N/I	N/I	A 15.25 m swath should be left around perimeter of field to minimize hazard to game birds
Abamectin	Field: 13.5-30 g a.i./ha in 3750 L water; Ornamentals: 10.8-21.6 g a.i./ha on 1000-4000 L water	0.003 (96h RT)	19.3	(29.1) 19.8	N/I	N/I	N/I
Acephate	562.5-825 g/ha	1.1 (96h RT)	10	N/I	N/I	N/I	Implant cartridges only for birch, elm, oak etc.Active under re-evaluation
Allethrin	0.04 g a.i./mosquito coil	0.0097(96h RT)	30	N/I	N/I	N/I	Used only in mosquito coils - domestic
Amitrole	2025-4050 g/ha | aerial for cattails 9900 g/ha	>180 (RT)	0	N/I	N/I	N/I	N/I
Ancymidol	0.25-0.50 mg a.i./15 cm pot	55 (RT)	N/I	N/I	N/I	N/I	N/I
Anilazine	1.6-3.8 kg a.i./ha in 380-1000 L water	0.15 (96h RT)	12-17	N/I	N/I	N/I	Being discontinued by registrant 12/15/05
Atrazine	1000-1520 g/ha	4.5-11(96h RT)	10-15	N/I	N/I	N/I	Active is under re-evaluation
Azinphos-methyl	312.5-387.5 g/ha in 1000 L water	20 g/L (96h RT)	35-42	34(43)-36(45)	>1000	580->1000	Use of all products for which alternatives exist will be phased out by the end of 2003, all other uses to be phased out in Canada by end of 2005
Bacillus thuringiensis	8.96-53.6 billion ITU/ha	>0.656 (96h RT)	0-8	2(3)-8(16)	0->45	N/I	N/I
Bendiocarb	0.83-1.1 kg a.i./ha	1.55 (96h RT)	N/I	N/I	N/I	N/I	Active is under re-evaluation
Benomyl	12.5-1550 g a.i./ha 550-1100 kg/ha on trees	0.17 (96h RT)	9-13	3(5)	0	N/I	All uses of benomyl are being discontinued in Canada; last date of sale 12/31/05 for domestic products, 12/31/03 for commercial products
Bensulide	2.3-5 kg/ha, 2.11-22 kg a.i./ha on turf	1.1 (96h RT)	4-42	N/I	N/I	N/I	PMRA re-evaluation document 04/03
Bentazon	840-224 g/ha	190 (96h RT)	0	N/I	0	N/I	N/I
Borax	244-1950 g/10m2	1320 (24d RT)	N/I	N/I	N/I	N/I	N/I
Boric Acid	560 g/200 m2	339 (48h RT)	N/I	N/I	N/I	N/I	N/I
Brodifacoum	11.1 kg/ha/0.001 bait; 25 ug/mouse; 0.1 mg/rat	0.051 (96h RT)	N/I	N/I	N/I	N/I	N/I

Active Ingredient	RATE a.i.	LC$_{50}$ (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
Bromacil	General weed control: 1.7-5.6 kg/ha Perrenials: 5.6-26.9 kg/ha	56-75 (48h RT)	0	N/I	N/I	N/I	WS formulation incompatible with ammonium sulphamate, weed oil and liquid formulations of aminotriazine, and may be precipitated by pesticides containing soluble calcium salts
Bromadiolone	0.005% at 1 or 2 feedings	1.4 (96h RT)	N/I	N/I	N/I	N/I	N/I
Bromoxynil	0.28-0.56 kg actual/ha in 23-114 L water	0.15 (RT)	23-25	N/I	10-160	N/I	N/I
Butylate	3400-4500 g/ha	4.2 (96h RT)	0	N/I	N/I	N/I	Should not be applied on milo. Sorghum, or corn seed stock
Captan	1.875-3.375 kg a.i./ha; 3.75 g a.i./kg seed; 0.5-7.5 kg/1000 L water	0.066-0.08 ppm (96h RT)"	22-28	22(32) -28(38)	200-540	N/I	N/I
Carbaryl	0.6-3.072 kg a.i./ha; 0.576-1.10 kg a.i./ha in 1000 L water	0.935-1.74 (96h RT)	79-86	75(86)-89(100)	>1000	>1000	Active under re-evaluation
Carbathiin	11-19 g a.i./25 kg seed; 9.69-10.43 mL a.i./25 kg seed	2 (96 h TR)	N/I	N/I	N/I	N/I	N/I
Carbofuran	0.26-0.53 kg a.i./ha in 800-1000 L water; 0.24-0.53 kg a.i./ha	0.38 (96h RT)	0-5	N/I	5-35	N/I	Active under re-evaluation
Chinomethionat	13-500 g a.i./ha	0.131 (96h RT)	N/I	0-4(8)	N/I	N/I	N/I
Chlormequat chloride	1.25-3 kg a.i./ha; 1:40 with water; 0.16-0.65 mL a.i./potatoe	>1000 (96h RT)	0	N/I	N/I	N/I	N/I
Chloroneb	9.29-17.88 kg a.i./ha/1500-2000 L water; 81.25-178.75 g a.i./100m2/15-20 L water; 0.91-1.81 kg a.i./1000m2	3.37 ppm (96h RT)	2-8	N/I	N/I	N/I	N/I
Chlorophacinone	50-250 mg/kg bait	0.45 (96h RT)	N/I	N/I	N/I	N/I	N/I
Chloropicrin	0.5-1.4 kg actual/28.3 m3; 0.5-2.7 kg actual/1000 bushels; 167-1196 mg actual/ha	0.91 (EC$_{50}$ 3h Daphnia)"	23.7	(33.9) 24.5	N/I	N/I	N/I
Chlorothalonil	Veg: 0.6-2.4 kg a.i./ha	0.076 (96h RT)	19-24	19(29)-25(34)	100	N/I	N/I
	Pot:		14-18	14(23)-19(28)	N/I	N/I	N/I
Chlorpyrifos	0.11-5.6 kg actual/ha	0.003 (RT)	40-46	42(52)-49(59)	>1000	N/I	Registration and sale of domestic class products were discontinued on 12/31/01; agricultural uses are being re-evaluated

Active Ingredient	RATE i.a.	LC_{50} (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
Chlorsulfuron	30,40, or 70 g/ha/surfactant	>250 (96h RT)	0	N/I	N/I	N/I	N/I
Chlorthal-dimethyl	13750-16250 g/ha	>4.7 (96h RT)	<4	N/I	N/I	N/I	N/I
Clofentezine	20-50 g a.i./100 L water	>0.015 (96h RT)	<14 -<20	<14(23)-<20(30)	N/I	N/I	N/I
Copper Sulphate	1.72-3.31 kg a.i./ha; 0.53 kg a.i./1000 L water; 6.88-13.75 mL a.i./100 L water	0.19-0.21(96h RT)	4-9	N/I	N/I	N/I	N/I
Coumaphos	0.28-0.55 g a.i./head	0.001 (48h Daphnia magna)	N/I	N/I	N/I	N/I	PMRA re-evaluation decision, 03/31/03 proposed acceptability for continuing registration
Cupric hydroxide	550-2250 g/ha	0.08 (24h RT)	10-17	N/I	N/I	N/I	N/I
Cyanazine	1.58-2.7 kg a.i./ha	9 (96h RT)	0	N/I	N/I	N/I	Discontinued, last date of sale 12/04
Cycloate	3-4.56 kg a.i./ha in 200-1123 L water	4.5 (96h RT)	0	N/I	N/I	N/I	Only technical registered in Canada; active cycloate under re-evalutation
Cyhalothrin- lambda	5.04-12.48 g a.i./ha	0.24 g/L (RT)	26	80	>1000	N/I	N/I
Cypermethrin	20-70 g a.i./ha	0.69 g/L (96h RT)	23-34	36(46)-39(49)	240->1000	N/I	N/I
Daminozide	1.1-8.9 kg/ha; 1.5-10.2 g a.i./L	149 (96h RT)	N/I	N/I	N/I	N/I	N/I
Dazomet	84-1121 kg/ha; 30-120 ppm in water; 0.06-0.48 kg a.i./tonne	640 mg/kg (Rat)	N/I	N/I	N/I	N/I	N/I
Deltamethrin	2.5-25 g a.i./ha in 10-1000 L water	0.91 g/L (96h RT)	17	15(24) - 17(26)	100	N/I	N/I
Diazinon	0.5-1.88 kg a.i./ha; 0.25-0.75 kg a.i./1000 L water; 4.83 g a.i./L water	2.6-3.2 (96h RT)	0	1-2(4)	N/I	N/I	Commercial products used non-agriculturally on lawn and turf are expected to be phased out by the end of 2003/2004; agricultural uses are being re-evaluated
Dicamba	0.11-0.14 kg a.i./ha; 1-2.21 kg a.i./ha in 110-220 L water	28 (96h RT)	0	(1.5)1.1	N/I	N/I	N/I
Dichlobenil	Aquatic: 4.5-17 kg a.i./haTerr: 4.4-22 kg a.i./ha	6.2 (48h daphnia)	0	N/I	N/I	N/I	N/I
1.3-Dichloropropene	60-228 kg a.i./ha	3.9 (96h RT)	27.2	(38.4)28.8	N/I	N/I	N/I
Dichlorprop	0.5-2.7 kg a.i./ha; 3-4 kg a.i./1000 L water; 0.8-1.1 kg a.i./100 L fuel oil	521 (96h RT)	0	N/I	0	N/I	N/I

Active Ingredient	RATE i.a.	LC_{50} (mg/L) RT=Rainbow Trout	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
			Ground	Air Blast	Aerial	Forestry	
Dichlorvos	300-1000 g/ha	0.93 (96h RT)	49-57	51(61)-60(70)	N/I	N/I	Active is under re-evaluation
Diclofop-methyl	0.7-1.4 kg a.i./ha	0.23 (96h RT)	6	N/I	15	N/I	N/I
Dicofol	0.3-3.9 kg a.i./ha in 1000 L water	0.12 (24h RT)	16-25	16(26)-26(35)	N/I	N/I	N/I
Didecly dimethyl ammonium chloride	646 mL a.i./10-15 L water	0.41 (96h RT)	N/I	N/I	N/I	N/I	N/I
Dienchlor	24.7 mL a.i. in 100 L water; 456 mL a.i./ha; 0.285 mL a.i. in 1 L water	1.8-2.1 (96h RT)	N/I	N/I	N/I	N/I	N/I
Difenzoquat	554-840 g a.i./0.67-1 ha in 100-400 L water; 554-840 g a.i./3.33-7.9 ha in 320-800 L water	694 (96h RT)	0	N/I	0	N/I	N/I
Diflubenzuron	20-48 g a.i./ha water surface; 0.5-1 g a.i./m2 surface; 37.5-68.75 g a.i./ha	140 (96h RT)	0	0	0	N/I	N/I
Dimethoate	0.48-0.72 kg a.i./ha in 1000 L water; 0.2-0.53 kg a.i./ha	6.2 (96h RT)	15-Sep	22(31) - 29(39)	70-480	N/I	Canadian sale of domestic class dimethoate products will end 12/31/04; commercial class products are undergoing re-evaluation
Dimethomorph	225 g/ha	6.2 ppm (96h RT)	0-50	N/I	N/I	N/I	Not registered for aerial application in the Atlantic provinces
Dinocap	68-228 g a.i./1000 L water	0.015 (96h RT)	20	21(30)	N/I	N/I	N/I
Diphacinone	0.005% concentration	2.8 (96h RT)	N/I	N/I	N/I	N/I	N/I
Diquat dibromide	300-1100 g a.i./ha; 2.2-4.4 kg a.i./ha	21.0 (96h RT)	15	N/I	N/I	N/I	N/I
Disulfoton	10.5-1130 g a.i./ha; 5.55-101.25 g a.i./100m of row	3 (96h RT)	26-33	N/I	N/I	N/I	Being phased out and discontinued in Canada with registration and sales ending 07/01/05
Diuron	5-53.6 kg/ha; 0.88-5.4 kg/ha in 250-400 L water	5.6 (48h RT)	11-14	N/I	N/I	N/I	N/I
Dodine	1.14-2.11 kg a.i./ha in 1750-4500 L water	570 ppm (96h RT)	0	0	N/I	N/I	N/I
Endosulfan	0.6-1.7 kg a.i./ha; 0.5-0.7 kg a.i./1000 L water	0.0014 (96h RT)	46-58	53(63)-66(77)	>1000	N/I	Active is under re-evaluation

Active Ingredient	RATE i.a.	LC$_{50}$ (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
EPTC	3.4-6.8 kg a.i./ha	16 (96h lake trout)	0	N/I	N/I	N/I	Active is under re-evaluation
Ergocalciferol	1-2 feeds	56 mg/kg (Rat)	N/I	N/I	N/I	N/I	Being discontinued, last date of sale 12/05
Ethephon	1 kg/2000 L; 875-2200 at 200 g/100 L;24-48 g/100 L	350 (96h RT)	0	N/I	N/I	N/I	N/I
Ethion	0.25-1 g/L water or 4.4-5.6 kg/ha	66 (96h RT)	0	N/I	N/I	N/I	Registration and use of product is to be discontinued 12/31/03
Etridiazole	450-900 g a.i. in 2500 L water/ha; 0-43 kg actual/ha; 0.79-0.12 kg actual/50 kg seed	0.77 ppm (96h RT)	11	N/I	N/I	N/I	N/I
Fenitrothion	0.14-2.2 kg a.i./ha	1.7 (96h RT)	24-30	N/I	"400 upwind, 100 downwind"	>1000	Active is under re-evaluation
Fenthion	0.5-1.0 mL a.i./100 kg	0.87 (96h RT)	0	N/I	N/I	N/I	Only uses registered in Canada are for lice/parasite control on beef cattle and nonlactating dairy cattl"
Fenvalerate	1-2 eartags/animal	3.6 g/L (96h RT)	N/I	N/I	N/I	N/I	N/I
Ferbam	1.1-16.8 kg a.i./ha	90 g/L (96h guppy)	14-29	14(23) - 30(40)	N/I	N/I	Active is under re-evaluation
Fluazifop-butyl	0.063-2 kg a.i./ha in 100-300 L water	1.37 (96h RT)	0	N/I	N/I	N/I	Only technical registered in Canada
Folpet	75-560 g a.i./100 L in up to 200 L water/ha	146 ppb (96h RT)	8-14	6(14)-8(17)	N/I	N/I	N/I
Formetanate hydrochloride	1-2.5 kg a.i./ha	4.42 (96h RT)	0	2(3)	0	N/I	Active is under re-evaluation
Fosamine ammonium	2.4-21.6 kg a.i./500-3370 L water/ha	>415 (96h RT)		N/I	N/I	N/I	N/I
Fosetyl-Al	2400-8000 g/ha	428 (96h RT)	15	0	N/I	N/I	N/I
Glyphosate	Annuals: 0.27-1.23 kg a.i./h, Perrenials: 0.89-4.27 kg a.i./ha	130 (96h RT)	15	N/I	0	N/I	N/I
Hexazinone	1-13.3 kg a.i./ha	320-420 (96h RT)	50	N/I	100	100	N/I
Hydramethylnon	12 bait stations/20 m2 surface	.16 (06h RT)	N/I	N/I	N/I	N/I	N/I
Imazamthabenz	0.4-0.7 kg a.i./ha	>100 (96h RT)	15	N/I	N/I	N/I	Not registered for use in Atlantic Canada
Imazapyr	0.25-1.5 kg/ha	>100 (96h RT)	15	N/I	N/I	N/I	N/I

Active Ingredient	RATE i.a.	LC_{50} (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
Imidacloprid	48 g a.i./ha, 1.68-2.4 g a.i./100 row	211 (96h RT)	15	40	N/I	N/I	N/I
Iprodione	0.5-11.25 kg a.i./ha in 100-1000 L water; 15-90 g a.i./100 m2	4.8 (96h RT)	0	0	0	N/I	N/I
Lime sulphur	3.45-23 mL a.i./L water	N/I	N/I	N/I	N/I	N/I	N/I
Lindane	0.125-1 g a.i./L water; 0.28-4.4 kg a.i./ha	0.002 (RT)	43-58	N/I	N/I	N/I	Sale and usage of these products in Canada will be phased out by 12/31/04
Linuron	1.08-156 kg a.i./ha in 225-335 L water; 1.08-2.2 kg a.i./ha; 4.32 kg a.i./ha in 400-600 L water; 1.1-3.3 mg/ha in 182-454 L water	3.15 (96h RT)	0	N/I	N/I	N/I	N/I
Malathion	0.5-2 g a.i./L water; 0.56-303 kg a.i./ha; 25-100 mL a.i./100 m2	0.2 (96h RT)	2-12	4(10)-13(22)	20-185	N/I	Active is under re-evaluation
Maleic hydrazide	2.25-3.39 kg/ha; 3.9-4.8 kg a/i//ha in 400 L water	1435 (96h RT)	0	N/I	0	N/I	Only the technical active is registered in Canada
Mancozeb	0.67-1.22 L a.i./ha; 80 g a.i./100 ks of seed; 0.83-1.69 kg a.i./ha	2.2 (48h RT)	50	N/I	100	N/I	N/I
Maneb	1.8-2.6 kg a.i./ha; 19.5-34.5 g a.i./25 kg of seed	1.9 (48h RT)	0	N/I	N/I	N/I	N/I
MCPA	0.13-2.2 kg a.i./ha in 23-455 L water	232 (96h RT)	0	N/I	0	N/I	Active is under re-evaluation
MCPB	1.4-1.7kg/ha in 150-200L water 276 kpa max pressure	75 (48h RT)	0	N/I	N/I	N/I	N/I
Mecoprop	3 g a.i./100 m2 in 20 L water; 0.55 kg a.i./ha in 300 L water	420 (48h Daphnia)	0	N/I	0	N/I	Active is under re-evaluation
Metalaxyl	1-2 kg a.i./ha; 1.02 g a.i./tree in 5 L water	>100 (96h RT)	0	N/I	0	N/I	N/I
Metaldehyde	2.24 kg/ha	75 (96h RT)	0	N/I	N/I	N/I	N/I
Metam	44-444 kg/ha; 380 g a.i./30 m2	0.079 (96h RT)	70.3	(85.1) 74.4	N/I	N/I	Active is under re-evaluation
Methamidophos	0.28-2.43 kg a.i./ha in 200-1000 L (ground) and 10 L+ (air) of water	25-51 (96h RT)	0	N/I	N/I	N/I	Active is under re-evaluation

Active Ingredient	RATE i.a.	LC_{50} (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
Methomyl	0.194-2.129 kg a.i./ha in 100-900 L water	3.4 (96h RT)	0	1-2	0	0	Active is under re-evaluation
Methoprene	31-448 g a.i. in water to make 5 to 45 L spray solution/ha	0.36 (48h Daphnia)	N/I	N/I	N/I	N/I	N/I
Methoxychlor	0.24-0.56 kg a.i./100 m2-ha; 625-1250 mL a.i./6-7.5 L water; 2.5-12.5 L a.i./30-255 L Diesel Fuel	0.0072 (48h RT)	40	N/I	>1000	N/I	Air application unlikely in Atlantic Canada
Methyl isothiocynate	9.35-180 L a.i./ha	0.37 (96h RT)	50.3	(63.1) 53	N/I	N/I	No end use products registered in Canada
Metiram	0.070-4.8 kg a.i./ha	1.1 (96h RT)	0	4(8)-7(15)	0	N/I	N/I
Metobromuron	1.125-3.375 kg/ha (depending on soil type)	36 (96h RT)	0	N/I	N/I	N/I	N/I
Metolachlor	1.68-2.64 kg a.i./ha	2 (96h RT)	50	N/I	N/I	N/I	N/I
Metribuzin	0.158-2.06 kg a.i./ha in 150-300 L water	64 (96h RT)	15	N/I	N/I	N/I	01/02 USEPA revoked certain residue tolerances for metribuzin
Metsulfuron methyl	3.5 g a.i./ha in 100-1000 L water	>150 (96h RT)	15-45	N/I	N/I	N/I	Not for use in Atlantic Canada
Mineral Oil	1.04-2.37 L a.i. in 100 L water; 18.95 L a.i. in 1000 L water	N/I	0	N/I	N/I	N/I	N/I
Monolinuron	0.7-2.2 kg/ha	56-75 (96h RT)	0	N/I	N/I	N/I	N/I
Napropamide	1.1-8.9 kg a.i./ha	16.6 (96h RT)	0	N/I	N/I	N/I	N/I
Naptalam	2.2-8.9 kg a.i./ha	76.1 (96h RT)	0	N/I	N/I	N/I	N/I
Nonyl phenoxy polyethoxy ethanol	0.225-2.25 L a.i./ha in 1000 L spray	N/I	N/I	N/I	N/I	N/I	N/I
Octyl phenoxy polyethoxy ethanol	0.5-1.25 L a.i./1000 L spray solution	N/I	N/I	N/I	N/I	N/I	N/I
Oxamyl	300-720 g a.i./300-1000 L water	4.2 (96h RT)	0	(1.4)1	N/I	N/I	Active is under re-evaluation
Oxycarboxin	62.5 mL/m3	19.9 (96h RT)	0	N/I	N/I	N/I	Active is currently being assessed and is expected to be renewed
Oxydemeton-methyl	300-564 g a.i./ha; 240-900 g a.i./100-1000 L	17 (96h RT)	0	0	0 - tobacco only	0	N/I
Oxyfluorfen	120 g/ha	1.5 (48h Daphnia)	0	N/I	N/I	N/I	Only technical is registered
Paraffin base mineral oil	2 L/ha in 100-400 L water	N/I		N/I	N/I	N/I	N/I

Active Ingredient	RATE i.a.	LC$_{50}$ (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
Paraquat	0.55-1.1 kg a.i. in 300-1100 L water	32 (96h RT)	45-55	N/I	N/I	N/I	N/I
Parathion	0.26-0.5 kg a.i./1000 L water; 0.22-0.7 kg a.i./ha	1.5 (96h RT)	0	1(1)	N/I	N/I	Active is under re-evaluation
Pebulate	4.4-8.8 kg a.i./ha in 225-1123 L water	7.4 (96h RT)	0	N/I	N/I	N/I	Only the technical is registered, active under re-evaluation
Pendimethalin	1.1-1.68 kg a.i./ha	0.14 (96h RT)	15-21	N/I	N/I	N/I	Not to be applied by air
Permethrin	0.056-0.22 kg a.i./ha; 0.625-2.5 g a.i./10 L water; 0.95 g a.i./ear tag	0.0025 (96h RT)	23-30	24(33)-31(41)	400 - >1000	N/I	N/I
Phorate	2.34-4.31 kg a.i./ha	0.013 (96h RT)	33-39	N/I	480-500	N/I	Phorate products registration expired 12/31/02
Phosalone	0.975-1.5 kg/ha	0.3-0.63 (RT)	N/I	5(12)-7(16)	N/I	N/I	Active is under re-evaluation
Phosmet	0.5-2.2 kg a.i./ha; 3.48 mL a.i./13.8 L water	0.23 (96h RT)	2-12	4(10) - 12(21)	N/I	N/I	Domestic products have been discontinued in Canada, commercial uses are under re-evaluation
Picloram	0.264-2.16 kg a.i./ha	29.2 (96h RT)	0	N/I	0	N/I	Granular formulations are no longer registered in Canada
Pirimicarb	75-850 g a.i./ha in 17-1000 L water	29 (96h RT)	0	0	0	N/I	N/I
Polybutene	2-4 kg/100 m3	N/I	N/I	N/I	N/I	N/I	N/I
Prometryn	1.2-3.4 kg a.i./ha in 200-1000 L water	2.5 (96h RT)	0	N/I	N/I	N/I	N/I
Propamocarb hydrochloride	1.01 kg/ha in 200-300 L water	422 (48h Daphnia)	0	N/I	N/I	N/I	N/I
Propiconazole	50.0-125 g/ha in 200-400 L water	5.3 (96h RT)	0	N/I	0	N/I	N/I
Propoxur	0.14-1.1 kg/ha	3.7-13.6 (96h RT)	0	0	0	N/I	Now registered commercially for mosquito control only, active is under re-evaluation
Propyzamide	0.45-2.25 kg/ha	>4.7 (96h RT)	0	1	0	N/I	N/I
Pyrazon	3.55-4.4 kg/ha	32-46 (96h RT)	0	N/I	N/I	N/I	Only technical registered, no end-use products are registered for use in Canada
Pyrethrins	0.56 kg/ha; Aerosol at 0.6 g/28 m3	0.0052 (RT)	N/I	N/I	N/I	N/I	N/I
Quintozene	75% a.i./dip solution; 187.5-202.5 g a.i./100 L water; 63.8-937.5 g/100 m2 in 15-40 L water; 6.75 kg a.i./ha	0.31 (96h RT)	20.6	(30.6)21.2	N/I	N/I	N/I

Active Ingredient	RATE i.a.	LC_{50} (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
Rimsulfuron	1.5-1 g a.i./ha	>390 ppm (RT)	10	N/I	N/I	N/I	N/I
Rotenone	0.56-2.2 kg a.i./ha; 1.5 mL a.i./3 L water	0.031 (96h RT)	N/I	N/I	N/I	N/I	N/I
Sethoxydim	0.1-1.1 kg a.i./ha; 0.8-4.4 L/ha	1.2 ppm (96h RT)	0	1	0	N/I	N/I
Silicon dioxide 80%	Apply dust thoroughly	N/I	N/I	N/I	N/I	N/I	N/I
Simazine	1.1-4.4 kg/ha; 1.6-4.4 kg a.i./ha in 300 L water; 4.4-6.6 kg a.i./ha in 550 L water	25 (96h RT)	0	0	N/I	0	N/I
Sulfotep	11.7 g a.i. in smoke; 1.75 mL/100 m3	0.00361 (96h RT)	N/I	N/I	N/I	N/I	N/I
Sulphur	56-196 kg a.i./ha; 5-8 g a.i./L water; 13.8 mL a.i./L water	N/I	0	N/I	N/I	N/I	N/I
Tallow fatty acid amine ethoxylate	2.35 L of Round-Up, Wrangler, or Laredo in 150 L (or more) water/ha with 0.5% Frigate	0.4 (96h Salmo trutta)	0	0	N/I	N/I	N/I
Tebufenozide	70-144 g a.i./ha; 120-240 g a.i./ha in 1000 L water	5.7 (96h RT)	N/I	15	0-350	0-350	N/I
Terbacil	0.44-22.4 kg a.i./ha	39.7 ppm (96h RT)	20	N/I	N/I	N/I	USEPA revoked certain residue tolerances 01/02
Terbufos	2.75-5.5 kg a.i./ha; 6.75-11.25 g a.i./100 m	0.01 (96h RT)	24-32	N/I	N/I	N/I	PMRA has proposed that uses of terbufos on canola and mustard be phased out by the end of June 2004, uses on corn and rutabagas are to be phased out by the end of 2003; PMRA has also proposed to continue to accept terbufos registration for control of"
Thiabendazole	3.6 kg a.i./8 L water, 0.23 kg a.i./500 L water, 6-24 mL a.i./13 cm diameter	3100 (Rat)	N/I	N/I	N/I	N/I	N/I
Thifensulfuron methyl	20 g Refine/ha	>100 (96h RT)	0	N/I	N/I	N/I	N/I
Thiophanate- methyl	0.44-1.58 kg a.i./ha, 1.23 kg a.i./ha in 1000 L water, 50 g/100 kg of cut potato seed	7.8 (48h RT)	0	0	0	N/I	N/I

Active Ingredient	RATE i.a.	LC_{50} (mg/L)	Aquatic Set Backs (m) (calculated set backs and label suggested*)				Usage Pattern Comments
		RT=Rainbow Trout	Ground	Air Blast	Aerial	Forestry	
Thiram	9.9-17.3 g a.i./25 kg seed, 131.25-225 g a.i./100 kg seed, 1.2 g a.i./10 m2, 16-378 mL a.i./100 m2	0.21 (48h Daphnia)	31-34	N/I	N/I	N/I	Active is under re-evaluation
Trichlorfon	1.2 mL a.i./50 kg body weight, 0.158-3.05 kg a.i./ha	0.33 (96h RT)	0-8	3(6)-8(17)	2-90	N/I	Active is under re-evaluation
Triclopyr	0.48-3.84 kg a.i./ha in 200 L water, 0.24-3.36 kg a.i./1000 L water	0.74 (96h RT)	N/I	N/I	4-487	4-487	
Trifluralin	0.420-4.38 kg a.i./ha in 100-450 L water	0.01-0.04 (96h RT)	50	N/I	N/I	N/I	N/I
Triforine	1.9 mL a.i./L water, 270 g a.i./100 kg seed, 190-360 g a.i./ha in 50-1000 L water	>1000 (96h RT)	0	0	0	N/I	N/I
Warfarin	0.025-0.5 % in water baits at 0.005-0.006 % levels, 0.5 % powder mixed with dry bait material at 19:1	N/I	N/I	N/I	N/I	N/I	N/I
Zinc phosphide	90-180 g a.i./ha, 0.3 g a.i./3 m	N/I	N/I	N/I	N/I	N/I	N/I
Zineb	1.4-2.6 kg/ha; 3.4-5.4 kg/ha	1850-8900 (Rat)	0-1	1(2) - 4(9)	N/I	N/I	Active is under re-evaluation

Notes N/I: Not identified in the literature